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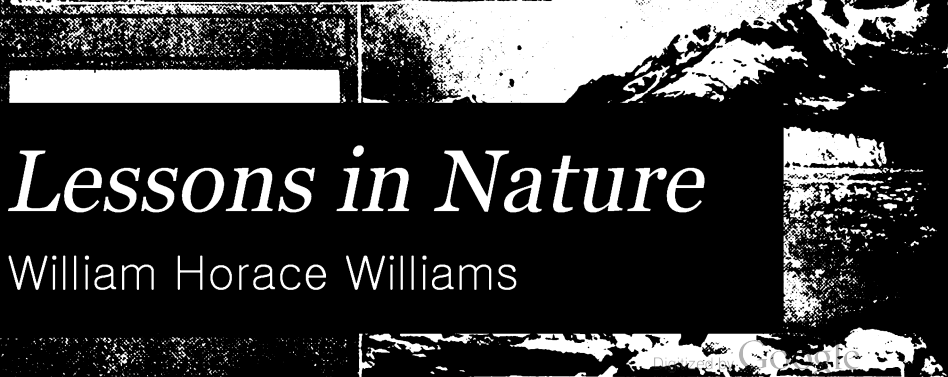
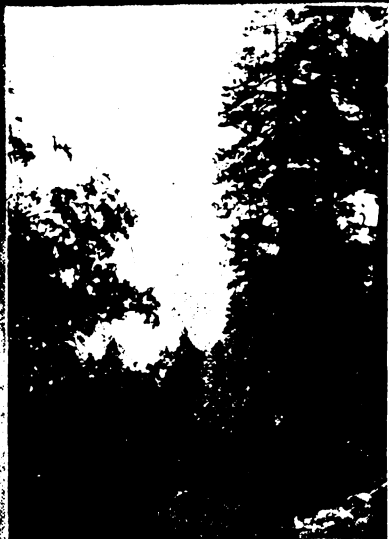
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Lessons in Nature

William Horace Williams

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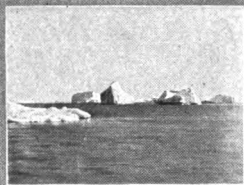
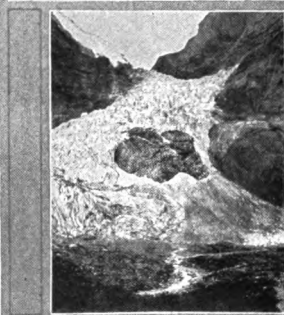
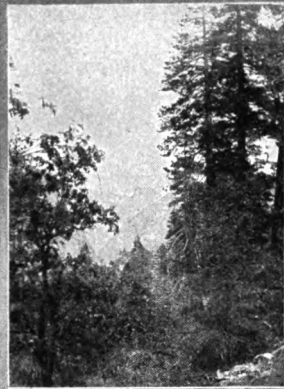
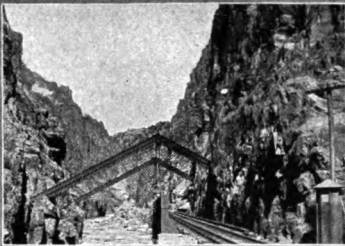
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Royal Gorge, Colorado.
Grand Canyon, Colorado River.
Icebergs, Greenland.

View in Yosemite Valley.
Grindelwald Glacier, Switzerland.
Muir Glacier, Alaska.

LESSONS IN NATURE

A BOOK THAT IS FULL OF CONDENSED INFORMATION LESSONS UPON THE STUDY OF NATURE. IT IS A WORK FOR REGULAR CLASS-EXERCISES IN GRAMMAR GRADES OF PUBLIC SCHOOLS; FOR CLASSES IN PRIVATE SCHOOLS; FOR REGULAR SUPPLEMENTARY WORK IN ANY KIND OF ELEMENTARY SCHOOLS; FOR LIBRARY REFERENCE AND FOR HOME READING. : : : : : : : : :

BY

W. H. WILLIAMS,

Principal Thacher School, Kansas City, Mo.; Author of "Lessons in Art," "A Mental Drill-Book in Arithmetic," and "Memory Gems for School and Home."

VOLUME I.

Nature! great parent! whose unceasing hand
Rolls round the seasons of the changing year;
How mighty, how majestic are thy works!
With what a pleasing dread they swell the soul
That sees astonished! and astonished sings!

—Thomson.

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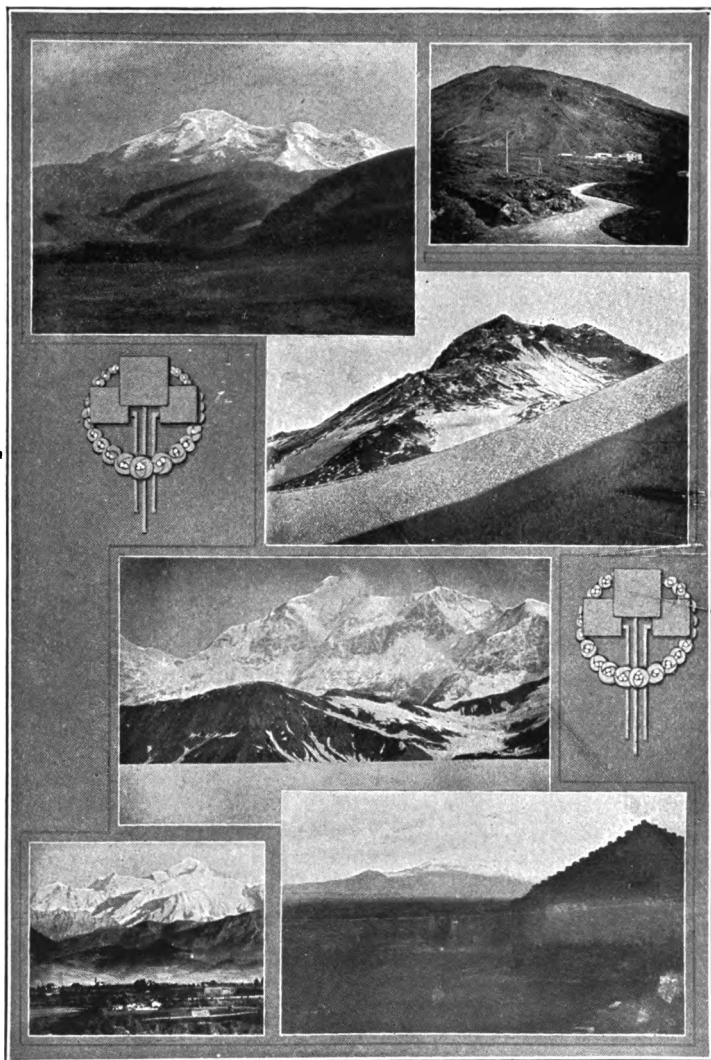
W. H. WILLIAMS.

DEDICATION.

To the cherished memory of my highly honored and distinguished friend, the late

DR. JAMES M. GREENWOOD,

A great educational worker; one of the leading educators of America; for thirty-nine years Superintendent of Kansas City Public Schools, and under whom I served as Principal for twenty-nine years, this work is most respectfully dedicated.



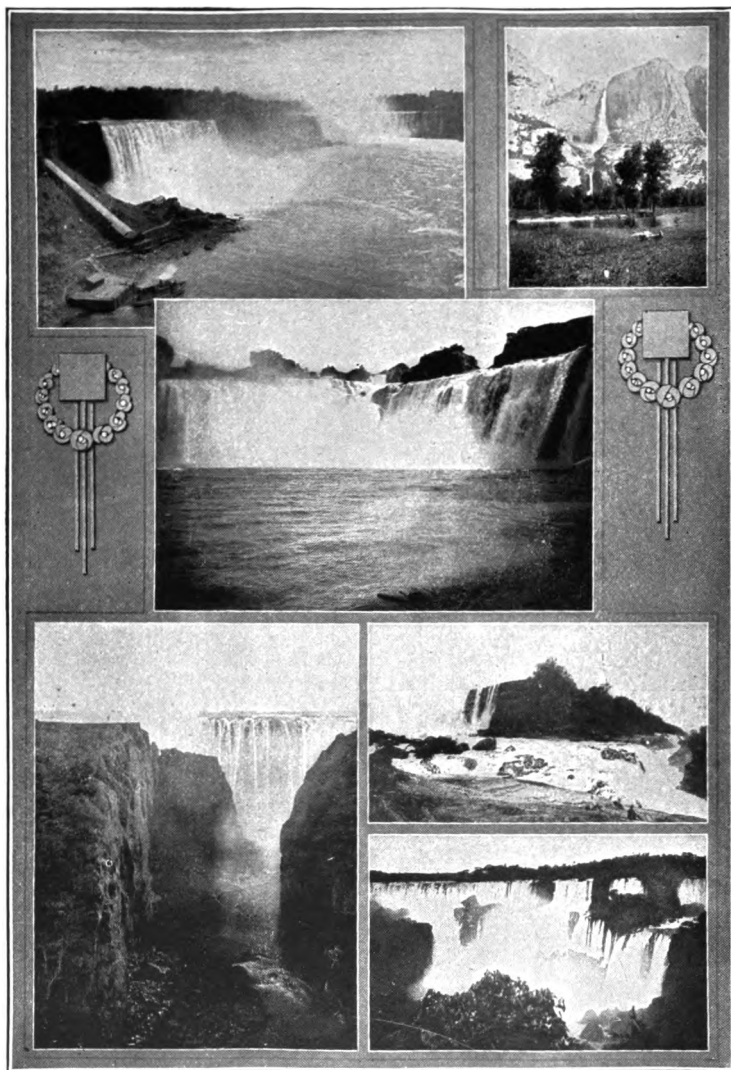
Mount Vesuvius.
Mount Cotopaxi.
Mount Chimborazo.

Mount Aconcagua.
Mount St. Elias.
Mont Blanc.

PREFACE.

"Lessons in Nature" contains one hundred and seven condensed lessons. The subject is so vast and all-comprehensive that no attempt has been made to give more than short sketches upon things that often we find occupying the pages of a volume; yet these sketches treat briefly upon wide areas in the fields of Nature around us. The work was prepared as a companion book to the author's "Lessons in Art," in two volumes, published by the Educational Publishing Company of Boston. He wishes to acknowledge with grateful thanks the valuable help he has received from all of the many sources of information at hand when he wrote—the long list of books on Natural History read; the many editions of magazines; scientific treatises on special subjects; travel sketches; guide books; all of the standard encyclopædias; Webster's Dictionary; the Consular Reports of different countries; the newspaper clippings; many private letters; the World's Almanac for 1913; many of the latest works on geography; and the works of a long line of authors on special departments of Nature Study, found in the Public Library of New York City, where nearly all of the work was written during the summer vacation of 1913.

Kansas City, 1914.



Niagara Falls.

Victoria Falls, Africa.

Shoshone Falls.

Yosemite Falls.

Iguazu Falls, So. America.

Laja Falls, So. America.

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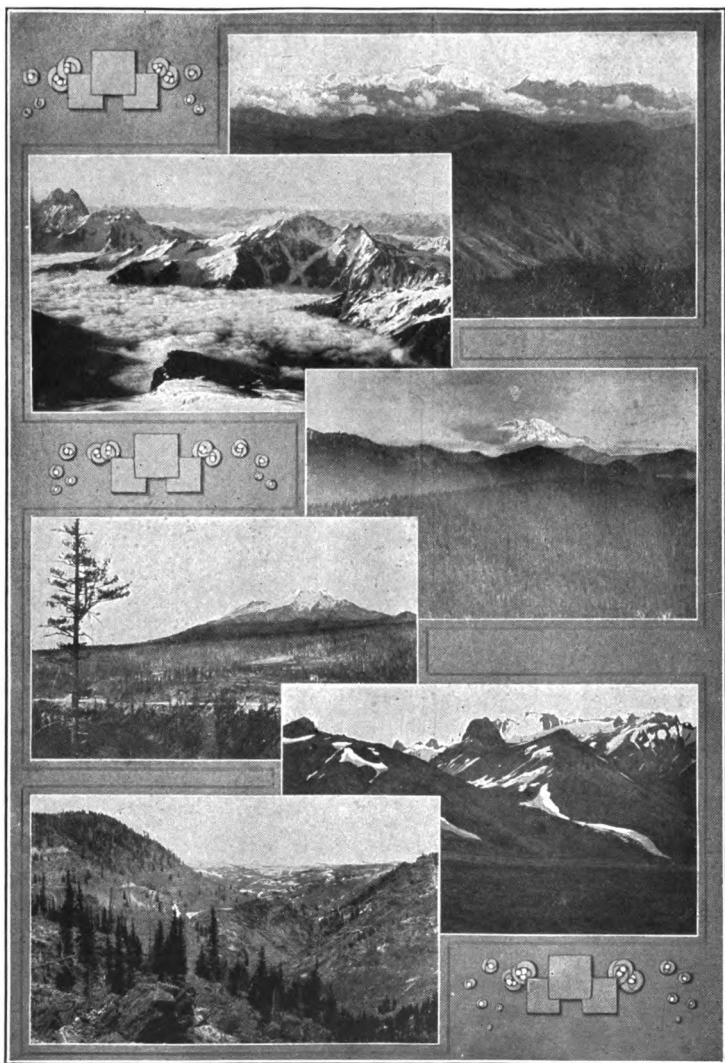
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High Andes Mountains.
Mount Ranier.
Marshall Pass.

Himalaya Mountains.
Mount Shasta.
Caucasus Mountains.

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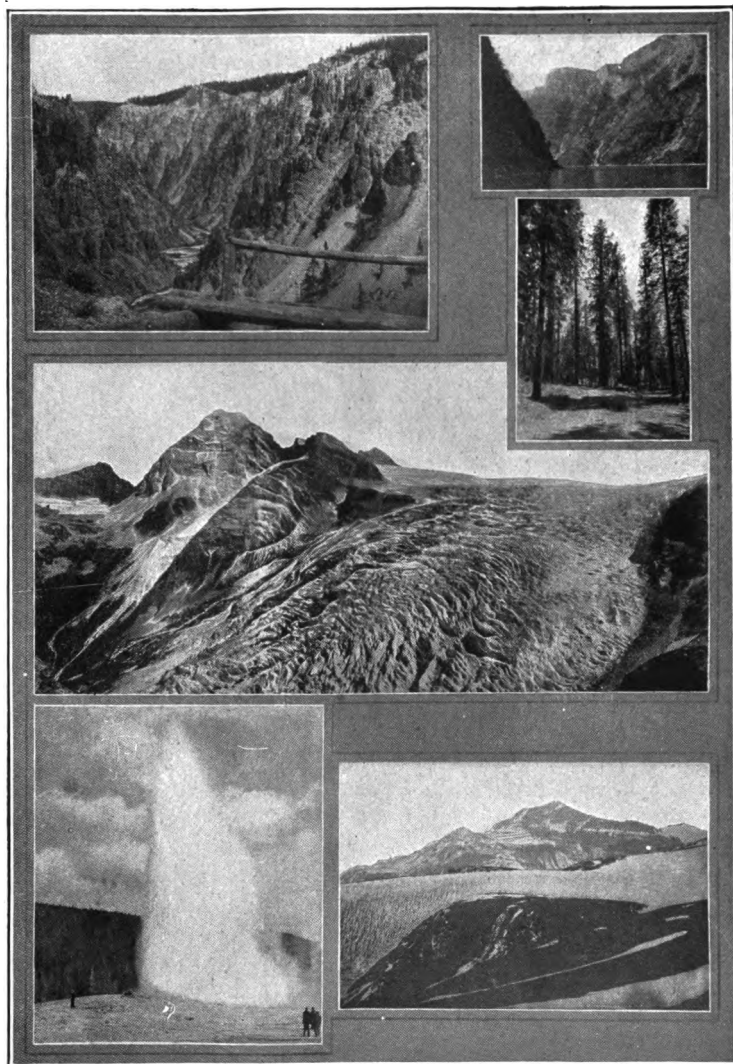
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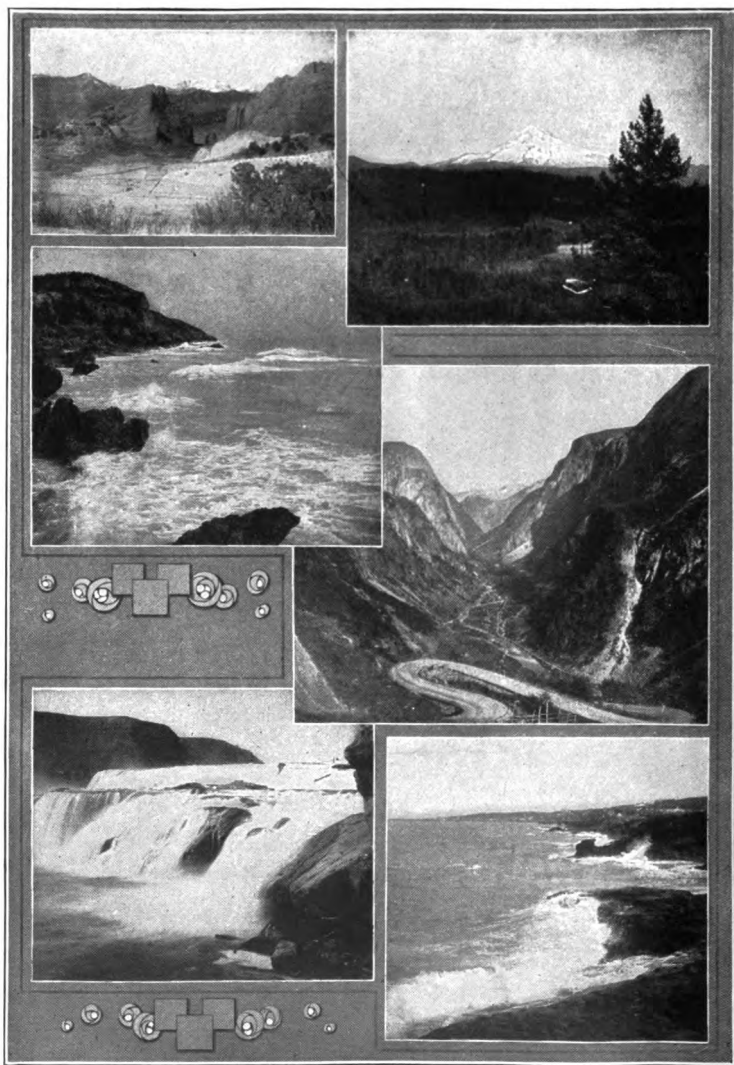
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Grand Canyon of the Yellowstone.
Illicilliwaet Glacier, Canada.
"Old Faithful," Yellowstone Park.

Nord Fjord, Norway.
Andean Glacier.



Pike's Peak, from Garden of the Gods.
 Rocky Shore, Atlantic Ocean.
 Great Falls, Montana.

Mount Hood.
 Naerodal Pass, Norway.
 Bermuda Surf.

INTRODUCTION.

All are but parts of one stupendous whole,
Whose body Nature is, and God the soul.—*Pope.*

NATURE.

Nature is the gloriously beautiful work of the Supreme, All-wise, and All-powerful Creator—the gorgeous panorama and exhibition of all the wonderful things made by the All-mighty and Eternal Worker. Sir Thomas Brown said:

“Nature is the marvelous art-work of God.”

Psalm XIX. says:

“The heavens declare the glory of God;
And the firmament sheweth His handiwork;
Day unto day uttereth speech,
And night unto night sheweth knowledge.”

DOMAIN OF NATURE

In its real sense Nature is without bounds or limits of domain. It is the boundless universe. For ages man has been searching for the hidden and secret things in Nature. He has thoroughly explored what we call “the fields of Nature,” and has found many things that fill the mind with astonishment. In his researches he has divided the realm of what is called “the Natural World” into kingdoms, then divisions and subdivisions, and in the particular study of various kingdoms and divisions has named his findings as belonging to certain divisions of science, as, for example: the Science of Geology, the Science of Botany, the Science of Astronomy, and the Science of Chemistry. A great many most wonderful discoveries have been made in the rich and inexhaustible fields of Nature; at times it has appeared as if there could be but little left to find out; then other new and still more startling things would be found. All of the deep secrets of God’s marvelous creations in Nature can never be fully known. The greater, the deeper, the eternally expanding, and the all-comprehending thoughts of God, the Infinite Creator, will forever be too far and too high above the thoughts of man. Job asks (xi. 7) this question: “Canst thou by searching find out God? canst thou find out the Almighty unto perfection?” God Almighty is Creator. It is impossible. Man is a mere creature. “For

as high as heaven is above earth, so far are His thoughts above our thoughts, and His ways above our ways."

LAWS OF NATURE.

The visible and invisible realm of Nature is ruled by fixed and unchangeable laws. Some one has said:

"The laws of Nature are the thoughts of God."

There is a great law of life and of decay and death, and laws innumerable that control all things in every possible part of God's creation. Every visible and invisible thing in Nature is governed by some special and suitable law. Within even the grains of sand and the drops of water there is a hidden force. From the smallest atoms of matter to the bright and twinkling orbs that revolve in boundless space there is a great natural law that has been fixed for them. Nature is an immeasurably vast and law-governed whole, each body or part of which depends upon and joins with the other, but all ruled and controlled by one Great Creating Thought, one All-ruling Force, one All-supplying Source of Power and of Life.

VOICE OF NATURE.

Nature has a voice with many tones and variations. The voice of Nature is the voice of God, but our dull ears do not hear well enough to understand all that He says.

"There is no speech nor language
In which His voice is not heard."

Truly has it been said:

"There breathes for those who *understand*
A voice from every flower and tree;
And in the works of Nature's hand
Lies Nature's best philosophy."

"To him who in the love of Nature holds communion
With her visible forms she speaks a various language."

When the south winds come to announce spring, a new and joyful birth-time in the changing year, their harmonious voices gladly sing so loud that the daisies, violets, and flowers of all hues wake up in their wintry beds, put on their beautiful raiment, and, all perfumed, dance all day long with the tuneful gales. There is a voice of grief and sorrow in the mighty sea that moans and groans along the shore; a voice of power and

of might in the wild ocean storm; a voice of terror and of alarm in the roaring hurricane or the thundering volcano; and a voice of sadness and of melancholy in the wailing night winds that sing dirges in the tree-tops.

NATURE'S PRACTICAL LESSONS.

The works of Nature are the works of God. They are full of grand lessons. They teach us to be active: the silent but ever busy course of Nature goes on unceasingly—the birth, the growth, the bloom, the decay; all visible and invisible Nature is a scene of continual activity. They teach us their marvelous unity of plan and the harmony of all their parts. They teach us their beautiful order, regularity, economy, and wonderful arrangement and adaptation. Nature's works are perfect. We can not add anything to them. Shakespeare said:

"To paint the lily, to throw a perfume on the violet,
To smoothe the ice, or to add another hue
Unto the rainbow, or with taper light
To seek the beauteous eye of heaven to garnish,
Is wasteful and ridiculous excess."

Dryden said:

"God never made His works for man to mend."

NATURE'S SPIRITUAL LESSONS.

When we view the wonderful works of Nature as displayed in the snow-capped mountains, the roaring waterfalls, the mammoth icebergs, the flaming volcanoes, the mighty sweep of ocean billow, the uncountable starry orbs in the heavens, and the vast number of other objects of matchless workmanship, we feel the presence of a Great Power, a Mighty Being of unsurpassing goodness, back of it all. We are speechless before such amazing exhibitions.

The whole beautiful realm of Nature is a vast and glorious collection of object lessons presented to the eye and to the mind of man for him to contemplate. They appeal to his spiritual, his higher nature; they arouse his wonder; they fill his soul with worship for the Great Maker. The endless variety and forms of Nature's works teach man the visible glory and sublime majesty, the omnipotent strength and creative wisdom, the universal love, care, and goodness, the matchless rulership and control of the Great Supreme, All-

wise Creator—the Invisible, the Eternal, the All-pervading, the All-encompassing Spirit “that inhabiteth Eternity,” and who is full of truth, justice, virtue, beauty, power, love, and perfection. You are invited to study in this book some condensed lessons, covering a wide scope in the realm of Nature—which is the greatest and most wonderful subject that the human mind ever thought upon.

PART I.

INSECTS.

. CLASSIFICATION; OUTLINE.

Insects are little jointed animals not having back-bones. Their-bodies are divided into three parts: head, chest, and hind-body. They live upon every part of the earth, but the greatest number of them are found in warm countries. Great scholars have spent years and years studying the habits, lives, and forms of all sorts of insects, and they have arranged them in what are called orders, species, families, and classes. Dr. Packard, a writer on insects, says: "They number in species about 200,000. There are about 25,000 different species of bees and wasps; 25,000 different species or kinds of butterflies and moths; over 25,000 separate kinds of winged flies; 90,000 distinct species of beetles; 4,800 different kinds of spiders; and 800 different species of centipedes (said to have a hundred feet), and as many kinds of millipedes (said to have a thousand feet)."

Insects are divided into two general classes:

- (a) Those having wings.
- (b) Those not having wings.

Winged insects have been arranged in groups as follows:

- (a) Insects without wings (yet they can move through the air); as spring-tails, bristle-tails, etc.
- (b) Insects with small fore-wings; as ear-wigs, etc.
- (c) Insects with net-veined wings; as grasshoppers, locusts, katydids, moles, crickets, etc.
- (d) Insects with four net-veined wings (with mouth parts for biting); as bird lice, white ants, etc.
- (e) Species with net-veined wings (equal); as dragon-flies.
- (f) Selections with net-veined wings (unequal); as May flies.
- (g) Example of insects with mouth-parts having feelers; as thrips.
- (h) Insects having nerve-winged parts (net-veined); as lace-winged flies, ant lions.

- (j) Those having long and narrow wings (commonly called "snake-doctors").
- (k) Insects not net-veined; as caddis flies.
- (l) Those having front wings covering hinder ones; as horn bugs, beetles, and weevils.
- (m) Winged insects having bodies and long legs; as fleas.
- (n) Two-winged insects; as flies.
- (o) Four-winged and body-scale insects; as butterflies; and
- (p) Insects having four separated wings (hinder pair small ones) and a tongue; as wasps and bees.

All insects breathe through air-tubes, found in rows on different parts of their bodies. Those breathing-holes (or stigmata) differ in number, some having two pairs under their shoulders and eight pairs on sides of the abdomen (or hind-body). The number of the parts of the bodies of all winged insects is seventeen or eighteen; while the number of parts of the bodies of myriapods (ten-thousand-footed) varies from ten to two hundred. Of this class we have the ear-wigs, centipedes, thousand-legged worms, etc.

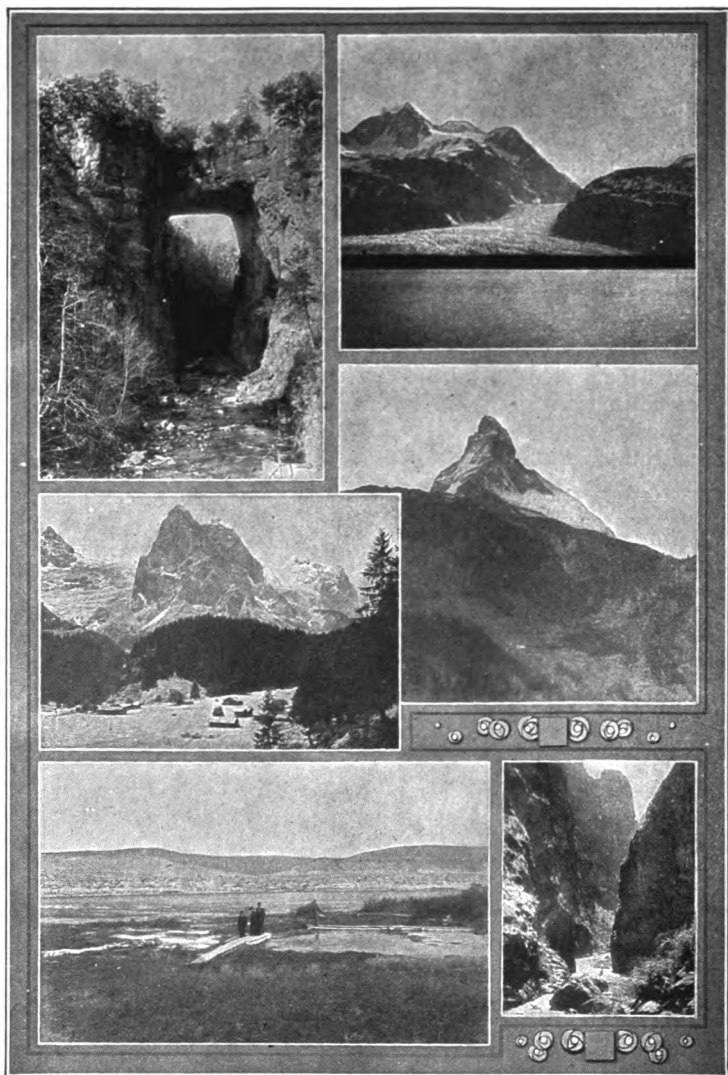
Insects make noises in several ways: some of them rub their legs against their wings; others, by rapidly moving their wings. Many insects with sheathed wings are capable of making light and are known as "luminous insects"; such as lantern flies, skip-jacks, beetles, and glow-worms. They have phosphorus on their bodies, which they can make shine whenever they want to. Many forms are "parasitic"; that is, they stick to the bodies of other insects, of birds, and of animals, and get from them the vigor of life. There are different families of parasitic lice; such as bird lice, animal lice, plant lice, etc. The longest-lived insects are bees and ants, some of which have been known to live seven years; the shortest, the May fly, which lives less than twenty-four hours. Many of the little animals which we call insects have remarkable strength. A cockroach will lift fourteen times its weight, and a bee, twenty times its weight. Some insects lay hundreds of eggs each day; for example, the white ant of Brazil.

Insects hear well; some of them can hear with their antennæ (or the "feelers"), which are like the long hairs around a

cat's mouth. Locusts have small ears on the under part of their bodies. Insects have keen sight. The eyes of some of them are adapted to see well, both in the day and at night, as well as in all directions at once. Their sense of smell is very acute, and it is by this sense that those which act as scavengers are aided in their work.

Insects are both helpful and harmful to vegetation. Some greatly help the growth of certain plants; for example, bees help to sow and fertilize clover and orchids. Flies, moths, and beetles carry pollen from flower to flower, thereby assisting in what is called "cross-fertilization"; while, on the other hand, it is estimated that the average loss to the United States from insects is about \$100,000,000 every year. It was estimated that a "Rocky Mountain locust campaign" which lasted four years caused a loss to the United States of \$200,000,000. The most destructive of all insects are the locust, army-worm, and chinch-bug. The number of injurious insects is greatly reduced by large flies, which eat them.

If we should study about insects a whole life-time, we would then find out that we were only just beginning to learn something about them. A story is told of a great scholar who had spent nearly all of his life studying about small insects. It was said of him that he knew more about beetles than any man who ever lived. When he was about to die, one of his friends asked him this question: "If you were to live your life over, what would you study most about?" He replied: "I should not try to learn all about beetles as I have tried to do, but I should try to learn all about the leg of one kind of beetle."



Natural Bridge, Virginia.
Bernese Alps, Switzerland.
Giant Spring, Montana.

Davidson Glacier, Alaska.
The Matterhorn, Switzerland.
Gunnison Canyon, Colorado.

I.

ANTS.

Go to the ant, thou sluggard; consider her ways, and be wise: which having no guide, overseer, or ruler, provideth her meat in the summer, and gathereth her food in the harvest. —*Proverbs vi. 6-8.*

A study of this little insect gives us many interesting facts. Those who have taken the time to look into the habits and lives of ants have discovered that there are many kinds of them. Some ants live above ground, making their homes in grass, wheat stacks, sand, and so forth; still others burrow in the ground, making chambers and separate apartments. Among the Ant family we find very much the same classification as among the Bees: there are males, females, and workers. The males are different from the females in this, that for a short space of time they have wings. The males are smaller than the females, and the workers are rather smaller than the males.

Ants defend themselves in three ways: by biting, by stinging, and by throwing out a poisonous acid from a little sack which is under their mouths. The workers take care of the ant eggs. When the little white grubs are hatched, they are, of course, perfectly helpless, and have to be taken care of until they are old enough to spin cocoons. At the right time the workers cut the cocoons open and let the little ants out. They then come out perfect insects, ready for the work before them. Ants are great warriors. Thousands of them organize in battle array against each other, and fight desperately. This

is the case when it is a "war of races," as, for instance, a war of black ants against red ants.

Ants will fight each other, gnawing their bodies in two, and when the battle is over, nothing but little pieces are to be found on the battle-field. These little insects have extraordinary strength, being enabled to carry loads often ten or twelve times their own weight. Ants, as bees, have a way of communicating with each other by interlocking their horns, or antennæ, the long feelers that stick out from the sides of their heads. They cross streams sometimes by linking their long feelers together and letting others walk over their bodies, as monkeys do. Amazon Ants capture prisoners in war and make slaves of them. There are many different kinds of Ants: the Black Ant, the Yellow Ant, the Red Ant, the Sugar Ant, the Mason Ant, the Horse Ant, and so on. Some species live in great dome-like structures, known as ant-hills.

Travelers in South America state that in some regions vast colonies of ants live in mounds or hills, frequently fifteen feet high. An inspection of ant-hills shows the most wonderful knowledge of geometrical science; their walls, chambers, galleries, and porticoes are built with exact mathematical proportion and according to the strictest laws of science. Some of the apartments are concave, some elliptical, some square, some longitudinal, and so on. Australian ants make nests of the leaves of trees glued together, after first being brought to place by the united strength of a great multitude of working ants; East Indian ants make nests of a thick, silk-like tissue; and all kinds of ants make comfortable homes for themselves out of some material or other.

The greatest enemy of the ant is the *Ant-eater*, a curiously made animal that has long, sharp claws, a long bill, and a sharp, oily-coated tongue. When an ant-eater appears where thousands of the little creatures are busily at work, the greatest terror is seen in the colony. The ant-eater at once digs into the hill with his long, sharp claws, darts his long, oily tongue away down into the center of the hill, and multitudes of ants stick to it. He quickly draws them into his mouth and swallows them, repeating this until he almost empties the entire ant-hill. He is the natural enemy of the ant.

Ant-eaters are found in South America. Their jaws are toothless, but are very long. They have glands under their jaws, in which is deposited a kind of fluid, which continually streams out on their long tongues. They dart their tongues back and forth into ant-hills and ant-holes, drawing out mouthfuls of ants each time.

If we but study, we can get valuable lessons from the habits of the smallest insects. They are controlled by what we call instinct, while we of the human family have the governing power (not always used) of reason. From the little ants we may learn the valuable lesson of industry. No other insect over which we have observation has more industry, pluck, and determination than the little ant. We must never despise the smallest or most obscure of God's creatures. In the life of each one there is a wise purpose and a good law of action and being. From the ants up to man, there is an ascending scale of life, a graded perfection, an infinite and glorious plan.

II.

SPIDERS.

Spiders are very numerous and are found in all parts of the world, but they abound to the greatest degree in warm, tropical countries. In the tropics spiders grow so large that they attack and capture small birds. This species is called the Bird-catching Spider. The spider is really not a true insect at all. True insects have six legs, while the spider has eight. The body of an insect looks as if it were divided into three parts, whilst that of the spider is composed of but two. Spiders have seven joints in each one of their legs, and the last joint is armed with two sharp little hooks, like the fine teeth of a comb. The front claws are called mandibles. They are not like mandibles of insects, because they move up and down. At the ends of the mandibles there are very small slits.

In the joints next to the end of the leg of the spider there is a little sack, full of poison. When the spider presses this poison through the little slit at the end of his foot, he at the same time sticks the little hook into whatever he wants to kill, and in this way the killing is done. Spiders do not bite; they stick things with the sharp hooks in the end of their feet. Some spiders have eight eyes, some six, and some only two. The position of the eyes is not the same in all species. The spider has his web-making machine at the end of his body. He forces out from his body a thin glutinous kind of substance that dries as soon as it touches the air, and forms into a delicate thread. These threads of

glutinous matter are forced out through a great many little holes.

All kinds of spiders have spinnerets; therefore all spiders spin webs of some sort throughout their lives. Some spiders spin the web as a trap in which to catch other insects of prey, whilst others do not catch their prey in webs, but run after them or jump at them, and catch them in that way. Some spiders weave quite strong and closely woven homes for themselves, and then out in front they weave a sort of maze or puzzle, which we call the web; and when any poor insect, like a fly, happens to alight therein and gets all entangled in the sticky web, out from its hiding-place runs the crafty and cunning spider and secures its prey. So the song of "The Spider and the Fly" is founded on facts.

When spiders lay eggs, they always wrap them around with fine silk webs, called cocoons, and the little "baby spiders" are hatched out from these cocoons. A great many little spiders are hatched out together from these cocoons, and sometimes they swarm all over the mother spider and nearly crush her. The mother spider is very good to them, and carries the little creatures on her back. In many species the female spider is larger than the male. Spiders are very brave and plucky, and in their wars will eat off each other's limbs and devour each other in the most savage style. The bite of a large spider is very painful, and has been known to cause death.

Spiders have been divided by Professor Walcknaer into a number of groups: Hunting Spiders, Wandering Spiders, Prowling Spiders, Jumping Spiders, Water Spiders, Wolf Spiders, Mason Spiders, Geometrical Spiders, Field Spiders, Cave Spiders,

Trap-door Spiders, Mouse Spiders, Tapestry Spiders, Tent-making Spiders, and the Venomous Tarantula.

III.

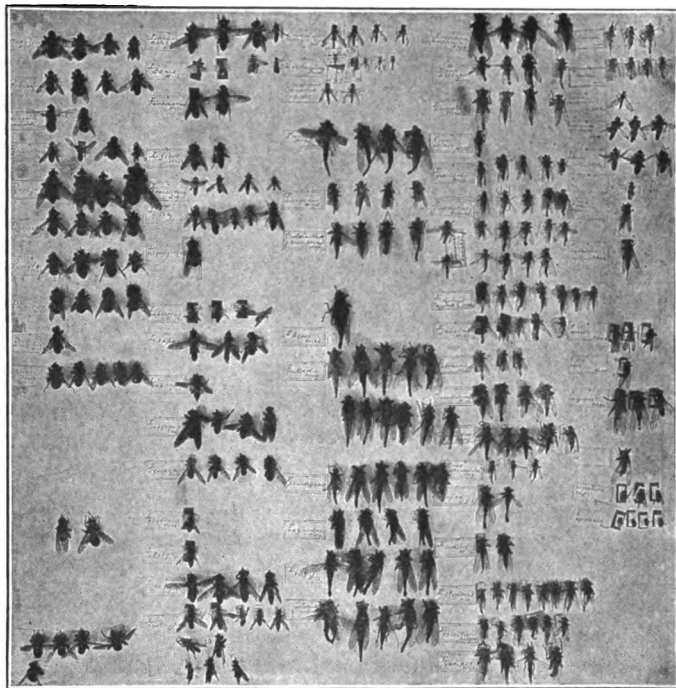
FLIES.

"A fly is a winged insect whose wings are transparent and have no cases or covers." This is the way in which we may describe flies so as to distinguish them from butterflies, beetles, and grasshoppers. The word *fly*, with the kind it is, forms the common name of many insects of various orders. It is a vast swarm, far too numerous to attempt to name, for there are the Lantern Fly, Ichneumon Fly (with 6,000 known species), Orange Fly, Bot Fly, Bee Fly, Cheese Fly, Corn Fly, Dragon Fly, Hessian Fly, Fire Fly, Black Fly, Horse Fly, Gad Fly, Syrphus Fly, etc., etc. A study of any one of these would be very instructive, but for the present we will devote to-day's study to the common *House Fly*.

We find that this little insect has a head of good size and that it is nearly all eyes. The fly has two large eyes on the side of its head, but these eyes are made up of about four thousand little eyes. Each one of these little eyes has six sides, so the fly can see all ways at once, and that is the reason the fly is so hard to catch.

Flies' heads are all eyes, we have said, and that is nearly true, for they have no noses and do not breathe through nostrils as we do. Flies breathe through holes in the sides of their bodies. Real flies have only two wings.

There are fourteen species of the common House



GROUP OF FLIES.

Courtesy of Department of Entomology, Kansas University.

Fly. Their feet are curiously formed. They have suckers on the bottom of them that spread out when they step on anything, no matter what the position of the body is. This arrangement enables a fly to walk on the ceiling, or on a pane of glass, or on anything in any position—head up or head down.

Flies do not have teeth. When they want to eat anything hard, they throw out from their trunk-like mouths a sort of fluid, which they carry in little sacks under their heads. This fluid softens the hard food; then they suck it and swallow it. The main work of the flies in the world is to remove filth, and they are always at work too; for flies are remarkably industrious. They are busy in removing garbage and eating up everything that decays; they are scavengers. City ordinances are established which compel all dealers in vegetables, fruit, meat, fish, etc., to screen their market-places, stores, and stands by wire gauze, so as to protect what they have to sell from the taint which flies would put on them if the articles of food were left exposed. Flies will eat nearly everything except pickles.

Did you ever notice a fly washing its face? It rubs its front legs over its head. Under its front legs are short hairs, and the fly rubs the dirt and filth off of its body by rubbing itself all over with its legs, and in this way they keep their bodies clean. Flies have six legs, so you see they can give themselves a good rubbing.

Flies live only one season, but they are exceedingly active and useful insects in nature. They are always eager and earnest in pursuit of what is designed for them in the world, and from this little insect we may learn the useful lessons of perseverance and industry.

FLIES AS CARRIERS OF DISEASE.

The diseases spread by insects are called "germ diseases," or those diseases which are spread by some such germ-carriers as the common house fly. Dr. L. O. Howard, an eminent authority on flies and insects in general, says in his book:

"The House Fly—Disease-Carrier."

"The agency of insects in the spread of human diseases is of two sorts: 1, mechanical carriers; 2, essential hosts. To the first group belongs the common house fly. Whatever disease germs adhere or stick to the body, feet, tongue, or wings of the fly in its crawling over filth, or those that are swallowed by it, may be deposited on food or in other places in such manner as to cause infection. The mosquito is a good example of the second group. One species is one of the necessary hosts in the development of the malarial parasite."

Another kind of mosquito, in the tropics, is responsible for infecting human beings with yellow fever. Dr. Howard says again:

"Typhoid is a parasitic disease or a disease which has been caused by some bacilli or germs being brought into water, milk, oysters, raw vegetables, and food of all kinds by contact, by dust, and by certain household insects, such as cockroaches, household ants, and undoubtedly and frequently by the 'typhoid fly.' Exact proofs are given in this work of flies carrying on their bodies disease germs which produced typhoid fever; proofs of flies carrying cholera germs and spreading that awful disease."

Scientific experts have proofs that flies carry from the germs found in the spittle of consumptives loads of bacilli, and that they help to spread tuberculosis. Proofs exist that flies help to spread the bubonic plague, but fleas and rats are the most active agents. Flies are carriers of small-pox germs and help to spread that terrible disease. Many notable proofs are given by such scientists as Nuttall,

Jepson, Howard, Hervieux, Dickinson, La Forgue, and Yersin, that the common house fly is a disease-carrier.

So you see the fly, so wonderfully made and generally considered so harmless, is in reality an active agent in the spreading of diseases that cause the death of thousands of human beings.

SOME PARTICULAR FLIES.

Black Flies are small, stout, strong-biting flies, with humped backs. They bite harder than the mosquito. Cases are on record where persons have been killed by innumerable bites from black flies.

Buffalo Gnats are allies of black flies. They, too, are strong biters.

Soldier Flies are flies with bright-colored stripes on their dark and metallic-looking bodies. Some of them have been found to breed in bee-hives.

Robber Flies are long, jointed, slender, but very strong insects. From their hard tapering beaks they thrust out a sharp lancet, cutting into their prey. Fitch says robber flies are inhuman murderers. They are the savages of the insect world. They capture nearly all of their insect prey on the wing. Robber flies include over three thousand species, four hundred of which inhabit the United States.

Dance Flies are small slender flies that have a peculiar habit of swarming in woods and moving about as if waltzing, gliding back and forth. Males carry little silk-like, web-like bubbles with them. Aldrich says they do this to attract the females. It is a large family, including over eleven hundred species.

Tachina Flies are small gray-colored insects, with

light and dark stripes. These flies are loud buzzers and fierce foes to leaf-eating caterpillars and army-worms, often checking the attempted ravages of the latter, as well as those of grasshoppers. They alight upon caterpillars, army-worms, etc., and deposit a few eggs on their backs and cover the eggs with a thick, sticky, gum-like substance. The eggs hatch out little maggots, that bore into the fatty matter of the army-worms, caterpillars, etc., and finally, after penetrating some vital organ, the insect which has been bored into dies.

Screw-worm Flies belong to the large family of Flesh Flies. They do great damage to cattle by laying their eggs on any spot where the skin has been cut, and the eggs hatch out a screw-like worm, that bores into the animals, causing death.

Salt-water Flies are small clear-winged insects, found in alkaline and salt-water lakes. They drop their eggs upon water where no fish or reptile can live; the eggs hatch and millions of larvæ develop into flies, covering everything on the shore. Prof. Brewer says that Indians used to scrape up the larvæ and the flies, dry them, and then eat them as food.

Scorpion Flies are bright spotted-winged flies, with stout beaks, at the ends of which are the biting parts of their mouths. They have elongated tail-like bodies, resembling scorpions.

Snipe Flies are slender-bodied, long-legged insects, with smoke-colored wings and hairy, fur-like bodies. One species make conical pitfalls in the sand, in which to catch their insect prey. Nearly three hundred species are known, fifty of which are in the United States.

THE DOBSON, THE ANT LIONS, GOLDEN-EYED LACE-WINGED FLIES, SNAKE FLIES, TSETSE FLY.

The Dobson Flyer is a very large flying insect, having powerful biting jaws, two long tusk-like organs on the sides of its head, which are crossed when at rest, but when the insect is excited the pitchfork-like prongs quickly spread, ready to seize and pierce any object in reach. The female lays her chalky-looking eggs in masses the size of a nickel. In these egg masses as many as three thousand eggs have been counted. *The Dobson Crawler* is a terrifying-looking insect, with many sharp, thorny-looking feet, vicious-looking jaws, and a hard, jointed body. It pinches its prey after seizing it with its claws on the ends of all its feet.

Ant Lions are short four-winged insects, having club-shaped antennæ. Their heads are flat and jaws are long. They scrape up sand by their front legs, and when their head has a sufficient amount for a load, they jerk the head suddenly upward and backward and throw the sand to quite a distance. They construct cone-shaped pits, in which they catch, as their prey and food, all small insects that roll down the sides of them into the sunken surface below.

Golden-eyed, Lace-winged Flies are generally green-colored, or brown, or yellow, almost metallic and sometimes golden, insects of the Fly family. They are natural enemies to the whole species of plant lice, so injurious to so many valuable plants.

Snake Flies are insects very curious in structure. They have four filmy wings, long slender bodies, and a long tail. They live on other insects. They can live a long time without food. Stein, a German entomologist, kept one eight months without food.

but it was still living. There are about ten species of Snake Flies in the United States.

The Tsetse Fly is found in Central and Southern Africa. Its bite is the direct cause of the death of droves of such animals as cattle, horses, and goats. The flies at certain seasons alight in swarms and bite the animals. The animals know by instinct the dreadful effect of the bite of these flies, and they lie down, roll over on them, lash them with their tails, try to knock them off with their heads, rub them off against trees, plunge into water, and run away as fast as they can from them. A fly of the same species as the tsetse fly bites the natives, causing the "sleeping sickness," which results in the death of great numbers of people in African villages. Theodore Roosevelt, in his book "African Game Trails," says of tsetse flies:

"While on the Guaso Nyero trip, we had run into a narrow belt of the dreaded tsetse fly, whose bite is fatal to animals. Five of our horses were bitten, and four of them died."

Warble Flies lay their eggs on the feet and legs of cattle, and when the cattle lick them off, the eggs hatch out in the stomachs of the cattle, and they cause large and painful swellings, known by stockmen as "warbles."

HORN-TAILS, SPRING-TAILS, SAW FLIES, CRANE FLIES, GALL FLIES, ICHNEUMON FLIES.

Horn-tails comprise a family of insects which are allies of the Saw Flies. They have a protecting horn at the end of their bodies. It is supposed that with this appendage they burrow into plants, and often into trees. The Pigeon Horn-tail, a large American species, is the prey of the Ichneumon Fly.

Horn-tails differ from the true Saw Flies only in the fact that Horn-tails have only *one* spur at the tip, in place of two.

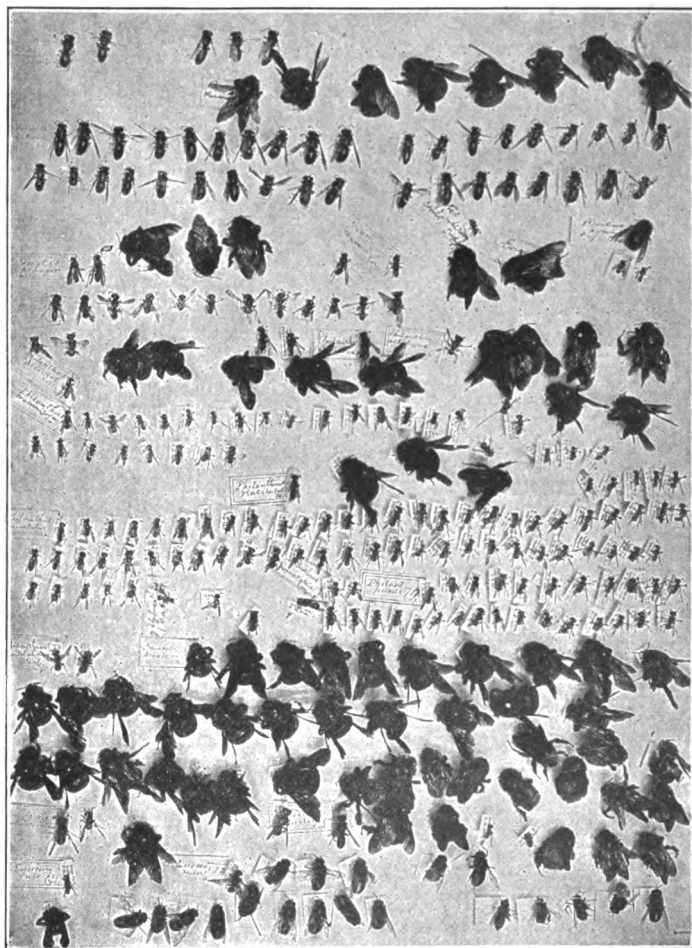
Spring-tails are small oval-shaped insects, having elastic appendage-like tails, which they bend under their bodies, then suddenly extend them like a spring, which throws the insect forward quite a distance. This continual bending and forcing their tail appendage outward is the insect's means of springing from place to place. The Spring-tails belong to the order *Physanura* (from the Greek *phýsanos*, fringe, and *oura*, tail), fringe-tail insects.

Saw Flies derive their name from the fact that the egg-depositing organ of the female is made so as to work like a saw. Under the body of the little insect there are two saw-like, thin, hard substances which can be shoved up and down, so that by the use of them the Saw Fly may make holes in leaves and vegetable stalks, in which eggs may be deposited. The larvæ of Saw Flies look very much like those of caterpillars.

Crane Flies are large, long-necked, and long-legged insects, sometimes called "daddy-longlegs." Sometimes they are mistaken for mosquitoes, but they differ entirely from mosquitoes—they do not bite, although they have a proboscis longer than that of a mosquito.

Gall Flies bite into leaves, especially leaves of oak trees, and lay eggs in the holes they make. There is a fluid that causes round balls to form about the eggs; these are called "gall nuts," and are used in making ink.

Ichneumon Flies belong to the "hunter family." There are more than six thousand species of them.



GROUP OF BEES.

Courtesy of Department of Entomology, Kansas University.

They have an auger-shaped boring apparatus, by which they bore through the skins of caterpillars and deposit their eggs underneath. The eggs develop into maggots, that eat upon the body of the caterpillar and cause death.

IV.

HONEY BEES.

All things in nature are wisely and wonderfully made, and it matters not in what department you look, you will find a great design, a wise Designer, and a grand work going on. Let us look at *Honey-making Bees*. There are over two hundred and fifty species of these known to be natives of Europe. It is not definitely known how many species there are in America. All bees live on juices they suck from flowers, and at certain times they make a sort of paste out of the juice of flowers, which is called "bee bread." This is really made of honey, paste, and pollen. Bees live in great communities, in swarms, and occupy what are called hives. A bee community is under very strict government, and all the business of the hive goes on in the most systematic manner.

Bees work to a common plan in everything, and there is a strict division of labor. There are always three kinds of them in every hive: females or queens, males, and workers. The males, called "drones," do not work. Male bees have no stings. The number of bees living together in a community has been estimated at from ten thousand to sixty thousand. In every community of them, whether it be large

or small, there is always one perfect female, called the "queen" or "mother bee." Only one full-grown queen can live in a hive at a time.

Most of the life of the queen or mother bee is spent in laying eggs. Sometimes queen bees lay as many as three hundred eggs a day. When the queen bee begins to lay eggs, great attention is paid to her. She has a body-guard of about fifteen other bees, which are continually feeding her on the richest honey, and a great many others are preparing cells for her to lay the eggs in. The moment the eggs are deposited, a whole delegation of servant bees take them in charge. The bee eggs will hatch in three days.

The little "baby bees" are short, worm-like creatures, having no feet, and lie coiled up in a ring. The "attendant bees" conduct these little creatures to cells that have been prepared for them, then they close up the sides of the cells with wax, and the little creatures stay in there twenty-four hours, when, all at once, they wake up, break through the wax partition, and come out perfect bees, ready to try their wings. The cell cradles for the queen bees are much finer apartments than are made for ordinary bees. The cells of a bee-hive are made with mathematical regularity. They are made on scientific principles, and there is the greatest economy of materials and of space. The waxen palaces are made to combine convenience, strength, area, and protection from the weather.

Sometimes strong swarms of bees plunder weaker ones and in the raid carry off all the honey they have so carefully gathered in one season. War among bees is very common, especially in warm countries.

During these wars the bees fight each other with great desperation. Bees are wonderfully industrious. A piece of bee comb 14 inches long and 7 inches wide, containing four thousand cells, is built by a community in twenty-four hours. After the "egg-laying season" is all over, the cells are used for some time to live in. All bees make their homes after the same plan, but these differ as to the grades of each particular bee. "Servant bees" do not live in as nice homes as the others.

Bees have hairs all over their bodies, and when they go down into a flower the pollen juice sticks to them, and they scramble up and out of the flower and fly away, carrying a heavy load to the hive. When they get to the hive, the heavy-laden bees are taken in charge by appointed delegations, and the pollen juice is all scraped off their bodies and carried back and piled up in a certain place in the hive, and then the "carrier bees" must fly away and bring back another load. Sometimes bees fly for many miles to get rich flower juice with which to make honey.

Bees have two large eyes on each side of their heads, with many telescopic lenses, so they can see in any direction, and besides these they have three small eyes in the top of their head, so they can look upward when they are down in a flower, or can see upward when they are fixing the ceiling of their hives. They can fly in a straight line night or day. They have four wings.

Bees have a very acute sense of hearing, as well as of seeing. They have wonderful sympathy and fellow-feeling for each other, and have a peculiar way of communicating certain kinds of news by inter-

locking their arms or antennæ. This means of communication is always taken at the time of the death or birth of a queen bee. Bees possess a keen sense of smell, and they are clean about their premises.

Among the ancient Egyptians the bee was the emblem of royalty, and in the hieroglyphic writings of the ancients, on their tombs and obelisks, we find pictures of bees, symbolic of industry, skill, and knowledge.

A swarm of bees consisting of twenty thousand will have one "queen," nineteen thousand five hundred "workers," and five hundred "drones." Whenever the queen is lost, the bees, as we have said, interlock their arms, and, we presume, mourn her loss a certain time; then they look about and find a cell which they make for a new queen bee. They get a "grub" and put in it, and this they feed on rich food until the birth-time. In sixteen days the "grub" changes to a queen, comes out from her waxen cradle, and is ready to assume royal functions.

A bee-hive is all bustle and hurry, yet all is orderly and well arranged. Every outlet is jammed and crammed with bees going out and coming in. All the bees are at work, except the lazy "drones." "Drones" simply live and gorge themselves with honey. When they become too offensive to be endured by other bees, the workers sting them to death. There are "police bees," which give the signal of the approach of an enemy; "laboring bees," which bring in pollen juice and leave it near the door of the hive; and "builders," which take care of this and carry it back into the hive. There are "mason bees," which are manufacturing cells; and "contracting bees," which are continually cleaning

out the refuse from the hives. Intruders are always stung. The little community works on day by day, building their waxen homes. How grand and wonderful the perfection of wisdom displayed by this little insect!

V.

EARTH-WORMS.

Again we are at the point where, upon examination, we see a great variety of different forms of life created by the Almighty for special and particular purposes. The subject of "Worms" is too extensive for a single lesson.

In the field of nature the following kinds of Worms have been classified: Earth-worms; Rock-worms (found under rocks); Sea-worms; Plant-like Worms (having a feathery crown), worms with bushy-looking gills; Round or Thread-worms (as *Trichinæ*, flesh-eating worms); Hair-worms (sometimes found tied up in a "Gordian knot" at the bottom of puddles, and are supposed to be a "horse-hair come to life"); Tape-worms, from 10 to 30 feet long, having upwards of eight hundred joints, found in the human body; and, last of all, Flat Worms.

Earth-worms are like a cylinder in form, and are many-jointed. They can climb straight up the sides of buildings or boards by means of short, sharp bristles all along the under side of the body, which act as legs. There are double rows of bristles along each side of the body, and the worm, by a peculiar muscular-like movement, crawls along, up, or down. When they want to burrow into the ground, they

thrust their throats (or pharynx) into the end of the head, which makes it swell, and then by this means push the dirt away on all sides when they first begin to bore, and after they get in they swallow the dirt, which passes through the body. By this process a worm is enabled to burrow to a depth of from 3 feet to 8 feet in the ground. Earth-worms are helpful to vegetation—they bore holes in the soil, and thereby allow the air and moisture to get to the roots of plants; but they are sometimes harmful, as they suck up cabbage, beet, and lettuce seedlings, drawing them into their holes. Earth-worms vary in length and size in different species and in different localities. Certain families of Earth-worms found in Africa measure from 5 to 6 feet when stretched out. As a general thing, Earth-worms are longer than Water-worms.

Worms are found all over the globe. Some of them have “feelers” or tentacles, and, so far as is known, their only sense is that of touch. Some naturalists think they have discovered in a few species the organs of sight and of hearing. The mouths of worms are supplied with strong jaws. Some worms are parasites. For example, the “Fluke,” a double-mouthed worm, will eat into the liver of the sheep and the deer, and cause a disease called “the rot.” In former times certain species of worms sucked blood, as the Leech, and were extensively used in medicine for bleeding; France using a million annually. Leeches are taken from their work of sucking blood from the flesh by putting salt on their heads. Leeches digest so slowly that a single meal of blood will last for one year.

The history of the “Tape-worm” is the same in

all animals. Some animals eat the eggs, and the stomach hatches them out. The human Tape-worm comes of eating diseased meat. The Trichina Worm is a parasite on hogs—that is, it sticks to them. It bores into the hog's flesh and lays its eggs, and unless these are killed by plenty of cooking, they will hatch out in the human stomach when eaten, and cause disease.

Some species of Worms are only to be seen and studied under a microscope. Of this sort are the "Wheel-bearers." They are about one-thirty-sixth of an inch in length.

The mission of the Earth-worms is to eat decayed flesh and other substances. They are always referred to as the meanest of living things. Such expressions as "vile worm of the dust," "low as a worm," "base worm," etc., are common. Worms are mentioned many times in the Bible. Job says: (xxi. 26) "They shall lie down alike in the dust, and the worms shall cover them." (xxiv. 20) "The worm shall feed sweetly on him; he shall be no more remembered." Mark ix. 44: "Where their worm dieth not," etc. Yet this meanest of all creatures, loathed and despised by man, shows the wisdom and glory of Him who is the Creator. It is Nature's revelation.

Bright and glorious is that revelation,
Written all over this great world of ours.
—Longfellow.

VII.

SILK-WORMS.

The cultivation of silk dates back to very remote ages. In Proverbs xxxi. 22 we find this expression, "She maketh herself coverings of tapestry; her clothing is silk and purple"; showing that in the time of Solomon silk was manufactured from the silk-worm. We read that mulberry trees, especially the white mulberry, were cultivated in China for the purpose of feeding silk-worms twenty-six hundred years before Christ. The process of making silk was known to almost all the ancient nations. The Greeks in the time of Aristotle raised silk-worms. They received the worms from the Persians and Phœnicians. In 530 A. D. Emperor Justinian got silk-worm eggs from India. This was the beginning of silk culture in Europe.

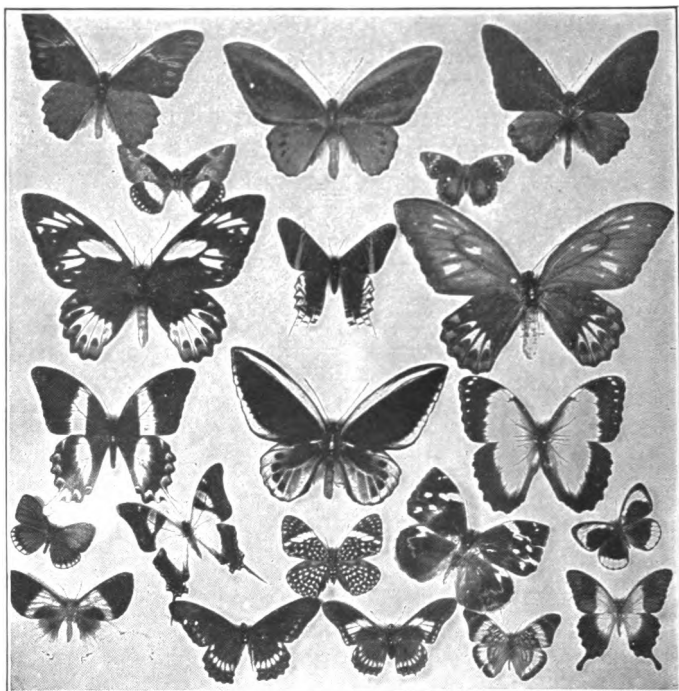
The common Silk-worm is a native of northern China. It is of a pale whitish color, and is about an inch long. The female worm is larger than the male. The silk-producing material is in two long sacks under the body. There are two little spinnerets in the mouth, through which the worms force a kind of sticky substance, which they press out from these sacks. This substance comes out in slender fibers or threads, which are always double, for the spinneret has two holes. The threads are sometimes over 1,200 feet in length.

The silk-worm is hatched from the egg of the silk-worm moth. The egg is very small, about the size of a pin head. When the egg bursts, a little creature comes out, and in two or three days it be-

gins to spin its cocoon. It does this by hanging itself by its feet to something and then forcing out the long threads from its mouth. These threads wind around and around and around its body, and after five days of winding and spinning and spinning and winding, the cocoon gets to be as large as a pigeon's egg. If the cocoon stays unmolested for three weeks, it will burst open in its natural way and a perfect silk-worm will come forth. The cocoon is the little creature's home or bed, where it stays until it gets ready to pass into its next change.

Persons who rear silk-worms always know when the cocoons are completed, for then the sound the insect makes in spinning the tiny little threads ceases. The silk-growers then take all the cocoons and put them in warm ovens, where the heat kills the chrysalis inside, and then the careful work of unwinding the delicate threads and fibers of the cocoon begins. This is exceedingly fine and particular work. Each cocoon will make about 300 yards of thread. After the thread of the cocoon is all reeled off and tied up in hanks, it is passed through a number of machines, and finally the bright silk threads are woven by the silk-weavers, ready to make up into silk garments.

The process of silk-making is a great branch of industry, especially in China, Great Britain, France, and Italy. The quantity of silk raised in the world is something enormous. About fifteen million pounds are manufactured in Great Britain alone annually. It requires sixteen hundred silk-worms to raise one pound of silk. Silk-worms are raised in many parts of the United States where climatic conditions are favorable.



GROUP OF BUTTERFLIES.

Courtesy of Department of Entomology, Kansas University.

VII. BUTTERFLIES.

And what 's a butterfly? At best
He 's only a caterpillar drest.

—John Gay.

Grimm says the name "butterfly" originated from the Old German word, *molken-dieb*, meaning "milk-thief." People used to believe that elves, witches, esprites, and butterflies stole cream, milk, and butter. Butterflies and moths are closely akin to each other and belong to the order *Lepidoptera* (from the Greek *lepis*, a scale, and *pteron*, wing), scale-winged insects. Butterflies have six scale-covered legs and two pairs of wings, fore-wings and hind-wings. Their bodies, wings and all, are covered with a sort of scale dust, like colored flour. Butterflies are divided into six general families, the first family of which comprises about five thousand species. The whole group includes many of the most beautifully colored insects. The rich and gaudy colors on the wings of butterflies are due to the layers of very small scales which cover the whole surface and overlap like the shingles on a roof. The mouth-parts are made for sucking up nectar from the open tubes of flowers. The butterfly is a four-legged insect, but its legs are very small and slim. When at rest, butterflies keep their wings folded.

Butterflies are developed from caterpillars. Caterpillars are hairy, worm-like animals. At a certain period in the life of a caterpillar a wonderful change occurs—from out its unsightly body comes the gay and beautiful butterfly, the most admired of all the

winged insects. Butterflies are to be found in all parts of the world and the rich colorings of their wings vary in different localities. Among such a vast collection of flying color insects, it is impossible to mention in detail very many of them. Some of the typical Butterflies are:

The Monarch, a milkweed butterfly, with the strongest power of flight of any other butterfly. A deep orange-red forms the ground color of its wings.

The Red Admiral, a very striking and dashing butterfly, with brilliant red over most of its wings.

The Painted Lady, a butterfly found over the entire extent of every continent, but not in the Arctic regions.

The Tiger Swallow-tail, a yellow-striped, orange-spotted butterfly of large size, found only in the temperate zone.

The Great Spangled Fritillary, a large brown-spotted, round-winged species of flyers, with large, silvery spots on the under side of its hind wings.

The Peacock, a gaudy butterfly, with brilliant spots on its wings resembling those on a peacock's tail.

The Viceroy, a pretty American butterfly, closely resembling the Monarch.

The Violet-tip, a handsome American butterfly with wings mixed with various shades of red, brown, and violet tips.

The Ursula, a fine North American butterfly, with wings which are purplish black with red and blue markings.

The Zebra Swallow-tail, one of the most elegant butterflies of the Southland.

The list covers far too much for this space or our

present time. There are the American Copper, the Orange Sulphur, the Cabbage, the Pearl Crescent, the Black Swallow-tail, the Northern Cloudy Wing, the Mormon, the Phaeton, the Gray Comma, the Pearly Eye, etc., etc., etc., etc.

No other insect gives us so much delight as these gayly colored flutterers that wheel and circle, rise and fall in open fields, meadows, at brooksides, and along roadways.

VIII.

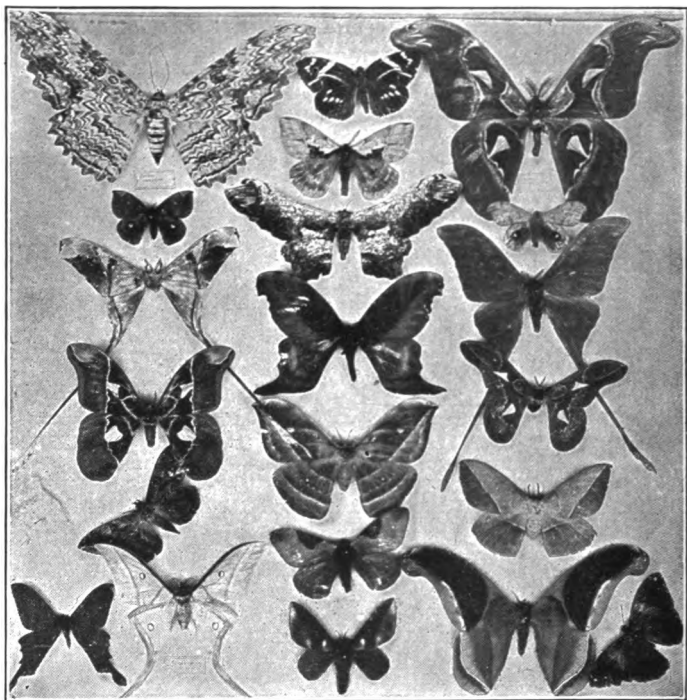
MOTHS.

Allied to the Butterflies are the Skippers and the Moths. Skippers are small, stout-bodied insects, sometimes regarded as butterflies, but in their structure they are more like moths. Their wings are somber-colored, not large. They have a habit of skipping and darting about in a strange manner. The great order of scale-winged insects is divided into two sub-orders: the Butterflies and the Moths.

Of all "the filmy shapes that haunt the dusk," as Tennyson says, none are more interesting than the moths and butterflies—

"That wave their limber fans
For wings, in all the liveries decked of
Summer's pride."

The difference between butterflies and moths is that insects of the order *Lepidoptera* having club-shaped antennæ are butterflies; those without are moths. Dr. David Sharp puts it this way: "All of the order *Lepidoptera* that are *not butterflies* are moths."



GROUP OF MOTHS.

Courtesy of Department of Entomology, Kansas University.

Moths are four-winged, six-footed insects, flying both in day and night, but mostly at night. They are found all over the world and their habits have been known from the earliest ages of history. Moths exist first in the egg; from the eggs insects appear as larvæ or caterpillars, which are usually enclosed in an outer silk-like covering, called "the cocoon." In time the cocoon separates and the moth appears. Dr. W. J. Dolland, in his great work, "The Moth Book," classifies forty-three distinct families of Moths of North America, north of Mexico. The vast families and species of even North American Moths is too great to attempt a mention of more than a few of them, and the North American Moths are but a fractional part of the Moths in the world.

Chinese Silk-worm Moths have been raised in China from the earliest times; the secrets of the manufacture of silk, guarded as a secret for centuries, were finally made known in the sixth century by two monks, who brought silk-worm moth eggs to Constantinople concealed in a hollow bamboo cane. The cultivation of the silk-worm then spread to all parts of Europe suited to its culture.

The Regal Moths, large handsome American moths with olive-spotted and yellow wings. Its larva, a horny worm, feeds on walnut, sycamore, and other trees.

Promethea Moths, fine American silk-worm moths with reddish brown wings. Its larva feeds on sassafras, wild cherry, and other trees.

Luna Moths, beautiful American moths with long tails and hind-wings; its wings are of delicate light green, striped with purple.

Leopard Moths, the most destructive species to city shade trees.

Sphinx Moths, a stout-bodied moth, that has a habit of resting with head and front of its body raised in the air, resembling, as some writers claim, the attitude of the Egyptian Sphinx.

Gypsy Moths, a small yellowish brown moth, a native of Europe. In 1869, a professor of Harvard University, brought some Gypsy moths from Europe to Boston. The larvæ escaped from his garden. In 1889 they had increased so that they destroyed every green thing. The State of Massachusetts appropriated \$775,000 for the extermination of Gypsy moths.

Tussock Moths, a common species of New England moths, having bright red spots on the body and black and yellow stripes on either side.

The filmy night-flyers comprise a vast flock with numberless specific names, but the leading families are classified with English names as: Hawk Moths and related kinds, Butterfly Hawk Moths, *Clear-winged Hawk Moths*, Swift Moths and their allies, *Tiger Moths*, Lackey Moths, Rustic Moths, *Geometric Moths*, Meal Moths, *Leaf-rolling Moths*, *Ermine Moths* and their kinds, *Leaf-mining Moths* and their allies, *Plume Moths*, *Carpet Moths* and all their allies that eat into woollen fabrics. There are other Moths, like the *Death's Head Moth* of France, the *Harlequin Moth*, the *Honeycomb Moth*, the *Bee Hawk Moth*, the *Buffalo Moth*, and so on.

The Bible makes several mentions of moths. Job xxvii. 18: "He buildeth his house as a moth, and as a booth that the keeper maketh." Isaiah l. 9: "Lo, they shall all wax old as a garment; the

moth shall eat them up." Matthew vi. 19: "Lay not up for yourselves treasures upon earth, where moth and rust doth corrupt, and where thieves break through and steal."

How wonderful the mechanism and the work of these myriads of night-flying insects of the air, the moths!

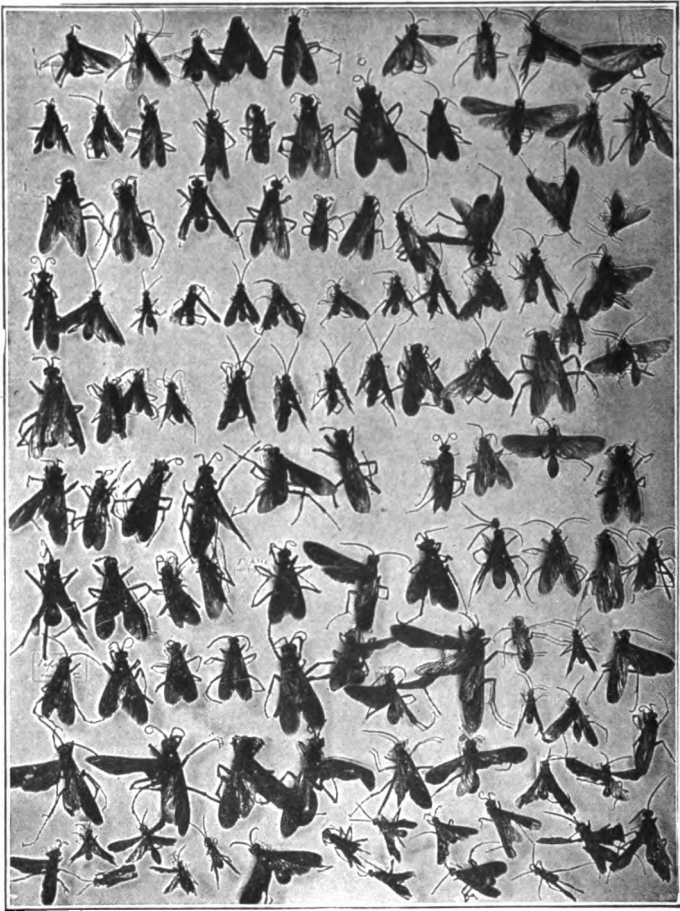
IX.

WASPS.

The name "Hymenoptera" is derived from two Greek words: *umen*, a membrane, and *pteron*, a wing. Insects of the order *Hymenoptera* include those which have four naked membraneous wings, lying when folded on their bodies and intersected by a network of nerves. The Bees, the Bumble Bees, the Ants, and the Wasps are the best known types of this order of insects. The Wasps belong to the family called the *Vespidæ* (from the Latin *vespa*, meaning "wasp"). The family *Vespidæ* also includes the Yellow Jackets and the Hornets, which are known from other Wasps by their great size. Wasps are of two general groups: the *Vespina*, or True Wasps, and the *Fossores*, or Digger Wasps. These groups include several hundred kinds.

True Wasps may be known by their wings, which are folded up like a fan down the middle. "*Social Wasps*," as they are called, live in companies, building their nests together. "*Solitary Wasps*" live alone and build their nests in out-of-the-way places.

Wasps' nests are wonderful exhibitions of the instinctive power of the little creature. The nests are made of a matter that resembles gray paper, which



GROUP OF WASPS.

Courtesy of Department of Entomology, Kansas University.

they get from rotten wood. They scrape the outside rotten covering off the wood and moisten it by a curious sort of liquid secretion, which they throw out from their mouths. These paper houses are tough and strong. The nests are arranged in the interior in the most methodical and mathematical manner. The little builders put up their paper houses like waterproof apartments with the greatest possible order. Like the bees, the wasps have overseers, workers, carpenters, lint-carriers, and helpers in all parts of their "flats." It is peculiar that they build from the top downward. Their papery houses or apartments are from fifteen to sixteen stories, composed of hexagonal-shaped tubes nicely glued together—all the tubes with open mouths or openings pointing downward and each story supported by many pillars, and the whole covered with layers of the gray paper-like substance, resembling in form shells of oysters, with one hole for entrance and another for exit, just large enough for one wasp to pass in and another to pass out at a time. Wasps' nests are remarkable for the exactness of the space taken, the arrangement for ventilation, the means of entrance and exit, the upholding columns, the exact size of the cells or tubes, the durability of the material, and the excellent plan in which each particular wasp has its own cellular home closed all around, but with its open entrance pointing downward. Several layers, with separated passage-ways, surround and protect the interior "flat," whose floors are so many hexagonal tubes.

Sand Wasps belong to a large family, called by entomologists the family *Sphegidae*.* They dig tun-

**Sphinges*, Hawk Moths—night-flyers.

nels in the sand and store up in them the bodies of insects, which they paralyze by stinging.

Digger Wasps are large ferocious insects, that dig great burrows in clay soil and store in them the bodies of insects they catch by stinging and numbing them.

Reaumur, in describing how a wasp's nest is made, says:

"They collect fibers of wood—which are their raw material—make them into a sort of coarse lint, which they make into balls, and carry them by their legs to the nest. The balls are then stuck on to the work already begun. Then the insect stretches them, flattens them, and spreads them into thin layers as a bricklayer spreads mortar with a trowel. Towards the end of the summer the nest, which is usually oval-shaped, like a pear, will have three thousand workers and many females."

Sometimes a hornet's nest is nearly as large as a bushel basket and built with exact nicety inside, and all of that peculiar paper-like substance.

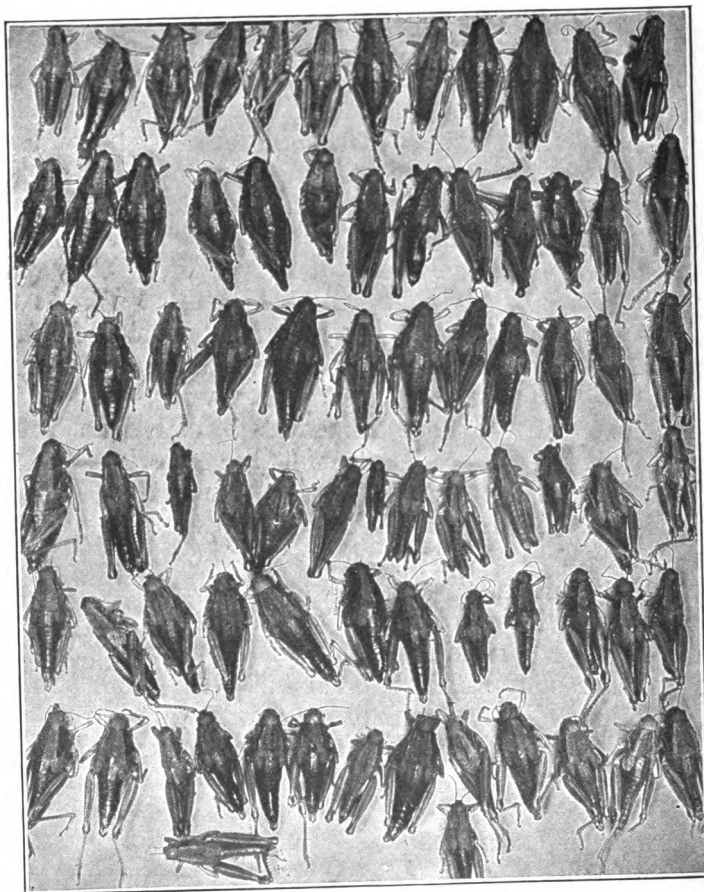
Wasps do not make wax. The males have no sting. A wasp hive consists of males, females, and workers. These little insects are bold highwaymen, that rob and kill. They kill flies, butterflies, caterpillars, and other insects, and often destroy honey bees when they find them heavily laden with pollen which they are taking to their hive. Some wasps sting their prey so as to paralyze them, and at other times they choke their prey with their strong mandibles.

The common and largest species of Wasps, the *Yellow Wasps*, build their paper-like nests of several galleries, with six-sided tubes pointing downward; the *East Indian Wasps* build their cells of clay, whilst another kind make nests in sandy loam; *Mud-build-*

ing Wasps, or Mud-daubers, build their nests of mud; *Carpenter Wasps*, much like the Yellow Jackets, burrow into decayed logs to make their nests; *Mining Wasps* dig tunnels in the ground, in which they put their prey; the *Card-making Wasps* of Cayenne make artistic-looking nests, resembling cardboard; *Bush Wasps* live in the woods and build their nests in shrubs and plants; *Potter Wasps* construct vase-like cells of mud for their young; *Huntress Wasps* build tubular cells of mud, about an inch deep and three-eighths of an inch wide, in which they put spiders they have bitten to death; *Bell Wasps* of South America build nests that are bell-shaped and hang from a slender handle; a certain kind of South American wasp makes a bag-like nest several feet long and crowds into it thousands of cells, the whole being covered with a hard crust-like covering. How wonderful the instinct of this little insect!

The wasp, like the bee, carries its sting in its tail. From the earliest ages to the present time "the fiery darts of wasps" have been known and written about. The sting of the wasp is barbed, and often, when the insect pulls its sting out from the person or animal which it has stung, the barbed lancet-like weapon is broken off or torn from the body of the insect, and then it soon dies. Morley says:

"The wasp has its place in the scheme of the world, and but for it hordes of insects destructive to vegetation might lay waste the gardens of the earth, even to the discomfiture of proud man himself."



GROUP OF GRASSHOPPERS.

Courtesy of Department of Entomology, Kansas University.

X.

LOCUSTS.

The Latin word *locusta* was first applied to the lobster or other shell-fish, and then, from its resemblance, to the very destructive insect which is found in many parts of the world. Locusts are often spoken of as grasshoppers, and they are hopping insects, yet they differ from true grasshoppers in several important respects. Scientific men tell us there are about fifteen hundred species of Locusts in the world, and out of this large number only twelve species have the habit of migrating to any great extent. From the several kinds of traveling locusts of the Old World many countries have suffered for ages, especially Egypt, Palestine, Syria, Asia Minor, China, France, Russia, and Germany. During some years the locusts have appeared in great numbers. There are many references in the Bible to the ravages committed by locusts. In Exodus x. 14-15 we read:

“And the locusts went up over all the land of Egypt, and rested in all the coasts of Egypt: very grievous were they; . . . For they covered the face of the whole earth, so that the land was darkened; and they did eat every herb of the land, and all the fruit of the trees which the hail had left.”

Locusts have been and are yet used as food in some Oriental countries. From modern translations of inscriptions on bricks in the ruins of Babylon and Nineveh, we find that locusts were commonly used as food. We read in Leviticus xi. 22 that locusts were classed among the “clean meats”:

"Even these of them ye may eat: the locust after his kind, and the bald locust after his kind, and the beetle after his kind, and the grasshopper after his kind."

Even John the Baptist ate locusts, for we read in Matthew iii. 4:

"And the same John had his raiment of camel's hair, and a leathern girdle about his loins; and his meat was locusts and wild honey."

In some countries of Africa locusts are dried, then ground into a sort of meal and eaten as bread. At Bagdad locusts are sold for food in the markets.

The areas traveled by migratory locusts are remarkable. The same locusts have been traced for thousands of miles. They travel from 5 to 20 miles an hour, according as the wind is blowing. They ascend sometimes to a height of from 4,000 to 13,000 feet, to get into higher air-currents; then they are carried along more rapidly.

The common Red-legged Locust, widely distributed throughout the United States, does not do as much harm to vegetation as the Rocky Mountain Locust.

The Locust swarm, like that of many other flying insects, is very numerous. Some of the special kinds are: *Lobe-crested Locust*, a large insect of South America and Central America, having a wing measure from tip to tip of 8 inches to 10 inches; *Green-striped Locust*, a large and showy insect of North America and Canada; and *Clumsy Locust*, a large flightless insect found in Kansas, Colorado, Wyoming, and other parts of the United States.

Locusts have been destructive pests for thousands of years. They have swarmed all over the world. They have produced famines and plagues and left

desolation in their track. In the central and western portions of the United States locusts destroyed 2,000,000 square miles of vegetation in 1873, 1874, 1875, and 1876. This terrible plague caused a loss of \$200,000,000 to the district infected.

Locusts make sounds by rubbing their legs against the outer edge of the first pair of wings. It is supposed that this noise is produced by males only. Some of the locusts live in caves and are blind and wingless. Locusts have many natural enemies besides man—birds, parasitic insects, bugs, and beetles.

Locusts have many allies or related insects—the nearest relative is the Grasshopper. Perhaps the most interesting species of the Grasshoppers is the Katydid, a large green insect, always dwelling in trees. It is a sure sign of warm weather—in fact, it is often called the “hot weather bird.”

Crickets are close relatives to Grasshoppers, of which there are various kinds, the most serious pest of which is the Mole Cricket.

Walking Sticks are insects related to Locusts, as are also Cockroaches, Mantids, and Croton Bugs. All of the allies or related insects to Locusts belong to the order *Orthoptera*, which means “straight-winged.” These insects have two pairs of wings and mouth-parts adapted to biting. The inside wings are folded straight on the back of the insect, and the outside wings, which are harder and thicker, are folded over the inside wings to protect them.

XI.

BUGS, TICKS.

BUGS.

The name "bug" is applied to many kinds of insects that have a sucking beak, resembling a tube. Such insects belong to the order *Hemiptera* (from the Greek *hemi*, half, and *pteron*, wing). Many forms are wingless, living on land and in water. The word *Hemiptera* refers to the fact that in some families of bugs the front part of their wings are hardened as a protection for about one-half of their length. The list of insects that are classified under the general name of "Bugs" embraces a great number.

Woods divides the whole order into sections: those having various wings; those having the same wings; those having no wings.

The order *Hemiptera* includes such insects as the following:

The Mealy Bug, a sort of bug covered with a white powdery substance found on the trunks of vines and on hot-house plants; *Water Bugs*, small gray and black insects found darting and swimming in ponds and streams; they can fly as well as swim; *Aphids*, or *Plant Bugs*, green oval-shaped insects that feed on the juices of house plants; *Scale Bugs*, small insects that have bodies which are scale-like in form; they attack all kinds of fruit trees and many kinds of shade trees.

There are more than eight hundred species of scale insects known, and it is certain that there are many more to be discovered and described.

One of the scale insects found on cactus bushes of Mexico is the source of the red coloring matter called cochineal; from another kind of scale insect of India lac is obtained. Several kinds of scale insects produce waxy substances in Oriental countries. White wax is produced from a Chinese species. The manna mentioned in the Bible is supposed to be the sweet substance from the secretion of certain scale insects and used now in Arabia as food.

Boat Bugs comprise a numerous family of water swimming bugs, so called because one pair of their legs are shaped like the oars of a boat.

Leaf-footed Bugs include a large family of sap-sucking bugs having leaf-like expansions and formations on their legs. They are very injurious to oranges, peaches, pears, etc., etc.

Potato Bugs are black-and-yellow-striped insects, large families of which do great damage to the potato vine.

Raspberry Bugs are small, nearly black fruit bugs, that feed on the raspberry, blackberry, and strawberry, giving them a very disagreeable flavor.

Tumble Bugs are various species of black hard-crested insects that dig holes in the ground and put balls of any sort of decayed vegetable matter in them. They lay eggs in the balls, so that when their larvæ are developed they may have food.

Sow Bugs and their allies, *Pill Bugs*, are small jointed bugs that have a habit of rolling up into a roll or ball; they are found under boards, logs, stones, and in dark, moist places.

Wheel Bugs are large American insects that suck the blood of other insects or the sap of plants. They have a high crest, which resembles a wheel.

Pea Weevils are small, dark-colored bugs that destroys peas by eating into the interior of them.

Emesas are slender, long-legged bugs that resemble the species of stick insects.

Bed Bugs are dark, rust-colored, flat insects, wingless, and supplied with a secretion having an unpleasant odor, which they emit when they are disturbed. Bed bugs are real blood-suckers, and are a scourge to any house they ever once get into. It is very hard to get rid of them. The female bed bug lays her eggs in summer in the crevices of furniture and on the wall paper of rooms. Its larvæ are small, white, and half-transparent. They grow to full size in eleven weeks. The mouth of the bed bug has a three-jointed proboscis, which forms a covering for the sucker, which is inside.

The Bug families comprise, like all the other great insect families, too many to give more than several types, and from these the student may see the vast field of study.

AMBUSH BUGS, LACE BUGS, COTTON STAINERS, STILT BUGS.

Ambush Bugs are fierce, yellowish green insects, tough and horny, with spines, and covered with a hard covering like plate armor. They stay about under yellow flowers like the ox-eyed daisy and seize all flower lice or ground insects to be found. The group includes only forty-three species, five of which are known in the United States.

Lace Bugs are little bugs having net-veined and strangely constructed wings that much resemble lace patterns. They are plant-feeders. Sometimes they

are found on sycamore trees. Three hundred and fifty species are known, twenty-five of which are found in the United States.

Cotton Stainers are stout, good - sized bugs, streaked with red. There are brown and black species. The Cotton Stainers are found from Pennsylvania to Central America. Their name is given from the fact that they stain the cotton when the bolls first burst by throwing on them a yellowish oily secretion which they emit from their bodies. Three hundred species are known, twenty-five of which are found in the United States.

Stilt Bugs are long, slender plant bugs, with thick thighs and slender hind legs upon which the insect often stands, and the two long antennæ standing out resemble a person walking on stilts. Only six species are known in the United States.

Stink Bugs and their allies, which include a large family of bugs—over four hundred species, three hundred of which are found in the United States. Usually they are flat, five-jointed bugs. They have the power of emitting from their bodies an extremely unpleasant odor when they are disturbed. To the group belong the Harlequin Cabbage Bug, the "Third Party" Bug, and the Spined Soldier Bug; all of which are great plant- and animal-feeders.

REAR HORSES OR PRAYING MANTIDS, TRUE LICE,
BIRD LICE, SQUASH BUGS, THRIPS, WALKING
STICKS.

Rear Horses or *Praying Mantids* are long-necked, bent-kneed, and long-bodied insects having large front legs, crooked and bent for grasping. They have a habit of rearing on their hind legs, looking

for their prey. The bent knees and position of the front legs resemble a worshipper at prayer holding his prayer-book. Flower mantids in tropical countries closely resemble some brilliant plants like the orchids in color. They hide in such plants and prey on other flower insects. In the Southern States Rear horses are called "Mule-killers," because of the belief that the brownish liquor which they exude from their mouths, if put on corn, oats, hay, etc., will kill the mules. Rear horses lay their eggs in tough cases and attach them to the twigs of trees.

True Lice are wingless, thin-skinned, hairy-legged, grayish-colored, round-headed insects, with mouth-parts consisting of a short tube furnished with hooks from which there extends a small sucking tube. They are not biters, but long suckers. They are always parasitic on warm-blooded animals. Mercurial ointment, when rubbed on the skin, will destroy the species that fasten themselves on the flesh of human beings.

Bird Lice differ from *True Lice* in this respect, that they have mouths with biting parts in place of mouths for sucking. They feed on the feathers and hair of birds or mammals. Water birds have bird lice on them as well as land birds, the close feathers always having a sufficient air-supply to furnish the lice for the time the bird is swimming in the water or diving beneath its surface.

Squash Bugs are yellowish brown or bronze-colored insects with a bad smell on them. They do great damage to all garden vegetables like pumpkins, squashes, etc., etc. The *Squash Bug* and its allies comprise about fifteen hundred species, two hundred of which are found in the United States.

Comstock classifies with the Squash Bug family several of the leaf-footed, thick-thighed, leaf-like limbed insects that have bodies shaped like a rifle cartridge. All of these bugs are plant-feeders, and some species are very destructive to crops. The Box Elder Plant Bug does much damage to box elder trees. A peculiar species of tropical plant bug carries its eggs upon its back.

Thrips are exceedingly small six-legged insects with long extended bodies covered with delicate hairs. The feet have bladder-like suckers at the end. Thrips do great damage to flowers and plants. They are only plant-sucking insects. Thrips frequently destroy timothy grass. They conceal themselves in the coverings of the grass and cause the heads to die.

Walking Sticks are among the most striking forms of all six-footed insects. They have long cane-like bodies, with long necks and scaly-like heads, with two sharp horns, generally crossed. They look like a twig or branch of some wood. They are plant-eaters. When seen crawling along up the plant, they present a strange appearance. The head and tail endings are so peculiar that sometimes it is difficult, when the insect is in certain positions, to tell one from the other.

SHORE BUGS, MARSH TREADERS, WATER BOATMEN,
CREEPING WATER BUGS, FLOWER BUGS, THIN-
WINGED BUGS, FLAT BARK BUGS, BOOK LICE,
TREE LICE, CHINCH BUGS.

Shore Bugs are black, brown, or drab-colored bugs with white stripings, found on all sea beaches. Some of them dig holes in the sand to deposit their

eggs in. They are carnivorous and feed on all other beach insects that they can conquer.

Marsh Treaders are slender, long-headed and long-legged insects, found crawling around on soft mud and stagnant pools. It has a habit of raising its hair-like legs to dry them off. There is only one species known of this aquatic bug.

Water Boatmen are oval-shaped, small, flat bugs that can dive under the water and remain for some time, as (according to Howard) "they carry down with them a film of air, held by the fine hairs which cover the body." The eggs, which are laid in enormous numbers, are made into cakes with meal and eaten by Indians and half-breeds around the lakes in Mexico.

Creeping Water Bugs are small, flat-bodied, oval-shaped insects with singularly shaped heads, a middle pair of short legs, and scaly bodies. They are constantly creeping up on some other insect with cat-like movements, always searching for their prey.

Flower Bugs are small, wing-covered insects with prolonged heads and striped bodies. They resemble the Bed Bug family. They are always found on flowers, where they hunt for plant lice or any other small insect for their prey.

Thin-winged Bugs are long-bodied, long-headed insects, with thin, filmy wings. Their front legs are large. From the head extend tentacles spreading like a steer's horns. They are usually found under stones, logs, etc. There are only twelve species known, two of which are in the United States.

Book Lice are little wingless insects found in between the leaves of old dusty books in damp places. They have been classed with another kind

of lice found in the bark of trees, especially old trees.

Flat Bark Bugs are small, flat, stoutly formed insects, usually found under the bark of trees. They look a good deal like the bed bug. There are about three hundred species, thirty of which are found in the United States. They are so flat that Comstock says they look as if they had been stepped upon.

Chinch Bugs are small bugs with white wing covers, upon each of which is an oval-shaped spot that is black; all the rest of the body is black and downy; the beak and legs are yellow. Young chinch bugs are wingless at first. Chinch bug eggs are laid in the ground about June 1st, and the bugs may be seen on grains and grasses during the summer. These bugs are very destructive to crops of wheat and corn, especially in the Southern and Western States.

LEAF-HOPPERS, SCALE INSECTS, PLANT LICE, BACK-SWIMMERS, WATER SCORPIONS, GIANT WATER BUGS.

Leaf-hoppers comprise an extensive group of differently formed insects, usually very slender, with antennæ inserted in front of and between the eyes. Prof. Osborn estimates that he saw a million leaf-hoppers on an acre of pasture land, and they ate up more grass than a cow.

Scale Insects, or Bark Lice, include a large group of six-legged creatures that feed on the sap or the fruit of trees and cause great loss to fruit-raisers. Dr. L. O. Howard, in his "Insect Book," says:

"The Scale Insects of the United States belong to three groups, the most abundant species of which is the Armored Scale, which is so called from the fact that as soon as the insect settles on a vine, bark, or plant, a wax exudes from pores

in its body and blends together, forming an impervious covering like armor."

Plant Lice.—The Jumping Plant Lice or Flea Lice are small insects, two-jointed in body, and have antennæ eight- or nine-jointed. The hind legs have large thighs. They jump like fleas, hence their name. Some kinds of them exude a sort of sweet liquid, known as "honey dew." The most destructive Flea Louse in the United States is the Pear Tree Psylla. Plant Lice comprise a vast number of species. Dr. Packard says:

"In summer female plant lice bring forth young, and, as there may be nine or ten generations, one plant louse may become the parent of millions of children and grand-children."

Back-swimmers are peculiar water bugs that have the habit of always swimming on their backs. They are strong enough to capture a small minnow. They pierce their prey with their sharp beaks, then grasp them in their strong legs and carry them under the water.

Water Scorpions have fore legs strong and made for grasping their prey like scorpions. The insect has a curious life-saving apparatus. It may have its head and nearly all of its body under water whilst an air tube from its tail brings air into the part of the body under water. Water Scorpions live principally upon the eggs of fish, but they also capture small water-going insects and small fish.

Giant Water Bugs, says Dr. Howard, "include the largest of living bugs. They are strictly aquatic in their early stages, living on aquatic animals, including fish." The fore legs of these bugs are made for grasping prey, the hind legs for swimming. They

are so much attracted by electric lights that they are commonly called "Electric Light Bugs."

Toad Bugs are ugly and odd-looking little insects, so much shaped like a toad that they have the name "Toad Bugs." They have short, broad bodies and eyes wide apart, that project like those of the toad. They live either in water or on land. Twenty species of Toad Bugs are known, three of which are found in the United States.

Assassin Bugs include a very large family of fierce biting bugs of over two thousand species, one hundred and fifty of which are found in our country. They are called "Cannibal Bugs" and "Pirate Bugs." One kind is called the "Blood-sucking Cone-nose." Another species is called the "Kissing Bug," so much written about in 1898, and the bites of which were fatal to many who were bitten *on the lip*.

WATER STRIDERS, CYCLOPS, CROTON BUGS, GRAPE HOPPERS, NEPAS, TOBACCO BUGS, OCEAN BUGS.

Water Striders are long-legged bugs that move with great rapidity about on the surface of the water, continually hunting for any water insect that may be on the surface.

Cyclops are small, free-swimming insects, known as "Water Fleas." They belong to the tribe of small swimming bugs. They have a large, single, compound eye in the middle of their head, and two pairs of antennæ, and two-branched appendage-like tails, which they use in swimming. The female in the summer carries about with her two large brood sacs filled with eggs, extending out from her body. The Cyclops increase in wonderful numbers. It has been estimated that the descendants of just one

Cyclops in a single year were 500,000 individual insects.

Croton Bugs are a small winged species of the Cockroach family. They are water bugs, and are commonly found on board ships and in houses where there are hot water pipes.

Grape Hoppers are small striped insects (yellow and red) that hop about on grape vines, doing great injury.

Nepas are also called "Scorpion Bugs." They feed upon other insects, which they sting.

Tobacco Bugs are small striped insects that suck the sap out of the leaves of tobacco and cause them to turn yellow.

Ocean Bugs are long-legged bugs, found on the surface of the ocean far from land. They are also called "Sea Bugs."

ARGAS, BIRD TICKS, CATTLE TICKS, SCAB MITES.

Argas.—This is a species of venomous tick which attacks man and animals. The famous Persian *Argas* is called the "Miana Bug." Its bite causes death.

Bird Ticks are winged insects that alight upon birds, get through their feathers, and when once fastened to the skin of the bird, they so remain until scratched or pulled off.

Scab Mites are small ticks that fasten themselves on to the flesh of sheep and cause the disease called the "scab."

Young ticks have six legs, but when they become full grown they have eight. Almost all of the Tick species carry disease germs.

Cattle Ticks fasten themselves on cattle in the warm regions of the United States and in tropical

content ourselves in reviewing only a small number of them, such as:

Tiger Beetles, a shining, metallic, bright-colored species, active and a terror to other smaller insects.

Bombardier Beetles, peculiar ground beetles, which, when discovered under some stone, emit a puff of smoke-like gas with a strong odor and a report like a pop-gun.

Blister Beetles, insects which, when dried and powdered, will raise large blisters when put upon the skin.

Diamond Beetles, large South American beetles, having bodies remarkable for splendid and brilliant colors, caused by little shining scales.

Goldsmith Beetles, large, bright yellow American beetles, gold-like in color, that feed on the foliage of trees.

Ambrosia Beetles, small wood-boring insects that bore deeply in wood and then feed on what grows in the tube they have made.

Carpet Beetles, small black, red, and white insects that do great damage to carpets.

Burying Beetles, so called from their habit of burying small dead animals and then digging away the earth under them so that their larvæ may feed on the decaying flesh.

Elm-leaf Beetles, small beetles that feed on the leaves of elm trees.

Flour Beetles, any of the various kinds of beetles or weevils that breed in flour and meal, thereby rendering such substances unfit for food.

Flea Beetles, any of a great family of beetles that live on vines and leaves of plants and leap like fleas.

Grain Beetles, small, sack-necked insects that feed on stored-away grain.

Fire Beetles, small night-flying insects that produce a bright, soft light from an organ in their bodies.

Ground Beetles, a large family of black, shining, horned beetles, that hide under stones and logs and destroy other insects.

Rove Beetles, any of a numerous family of swift-running insects that feed on decayed animal or vegetable matter.

Oil Beetles, a species of the Beetle family that, when they are disturbed, throw out from the joints of their legs a yellowish sort of oil.

Sacred Beetles, a species that were considered sacred by the ancient Egyptians. Sacred beetle images were placed on Egyptian mummies as symbols of the resurrection.

Stag Beetles, a large family of beetles that have long branching mandibles, looking like the antlers of the stag. They feed on the rotten wood of dead trees.

Soldier Beetles, any of several families of highly colored beetles that are continually fighting. They have something on their back resembling a soldier's uniform.

Ear-wigs are slender, many-jointed insects; much like Rove Beetles. They have a pair of large forceps-like appendages at the end of their bodies, the use of which is not yet known. They are supposed to creep into the human ear.

Bloody-nose Beetles, a large species, so named from the fact that, when disturbed, they emit a red fluid from their joints.

Click Beetles are a large brown-colored group of

America. Their bite leaves a parasite that festers and finally causes Texas fever, from which awful disease thousands of cattle die.

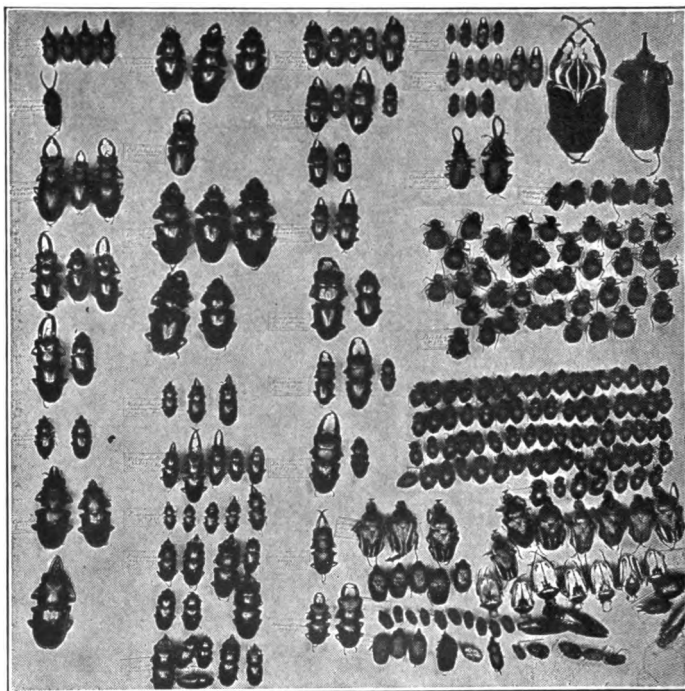
XII.

BEETLES.

The Old English word *bityl* meant "a biter." The name has been changed in its spelling and is now *beetle*. It is any one of a vast family of insects having two pairs of wings and six legs. When at rest, the wings are folded underneath two horny wing cases that fit over the insect's back. The wing cases are stiff; they aid but little in the flight of the insect, their principal use being as covers for the real wings.

Beetles belong to the order *Coleoptera* (from the Greek *koleos*, a case, and *pteron*, a wing), case-winged insects. It is one of the largest orders of insects, numbering over one hundred and fifty thousand in its various lists. More than eleven thousand species inhabit America, north of Mexico, representing eighty-three families. Since beetles do less flying than flies, bees, wasps, butterflies, and moths, we do not realize the enormous number of them.

If we should only mention all of the typical Beetles, we should have a list which would be very long. However, we may mention some Beetles of particular interest and study. Whilst the whole vast family is of interest, of course, and many great naturalists have spent years in studying the curious formations and habits of particular Beetles, we must



GROUP OF BEETLES.

Courtesy of Department of Entomology, Kansas University.

beetles that can leap up in the air when placed on their backs. Eyed Click Beetles have oval eye-like spots on their heads. These owl-eyed-like spots are to scare and terrify small insects.

FIDEAS, CARABUS, DERMESTES, LADDER BEETLES, HORN BUGS, RHYNCHOPHORES, RUTILIANS, PRUNER BEETLES, SAWYER BEETLES, RASPBERRY BEETLES, SUGAR CANE BORERS, BEAN BEETLES, HICKORY BORERS, MELON BEETLES, FUNNEL TWISTERS, OAK BEETLES.

Fideas are a small species of the Beetle family which are very injurious to grape vines.

Buprestidans are poisonous beetles, which, upon being eaten by cattle, cause them to swell up and die. One of the tribe of Buprestidan Beetles is of very brilliant colors, and bores into timber and is very destructive to trees.

The Carabus is a horned beetle belonging to a large family of ground beetles which are insect-destroyers. The whole tribe spend all of their time killing small insects.

Dermestes are small black beetles which are very destructive to dried meats, skins, woolens, and furs. They are called "Bacon Beetles."

Goliath Beetles are large insects, found in Africa. They are sometimes from 3 to 5 inches in length. They are of a dull white or yellow color, with spots of velvety black. They have horns, hooks, and arms with sharp, hard saw-teeth-shaped ridges on them. They are fighting beetles and have a fierce look.

Bee Beetles are a kind that are continually clinging to the inside of bee-hives. The larva form is called the "Bee Wolf."

Ladder Beetles are silvery white, striped with green, with under wings that are rose-colored. They are leaf beetles, feeding chiefly upon linden trees.

Rhyncophores are long-bodied beetles, with snouts. They are called "Snout Beetles."

Rutilians are stocky-shaped, spotted beetles that injure grape vines.

Pruner Beetles include several species that gnaw the branches of trees and cause them to fall; they also gnaw circular furrows on the inside of the bark of certain trees.

Sawyer Beetles are spotted, hard-crested beetles with very long antennæ. They bore holes in timber like white pine and fir trees, often killing them.

Bean Beetles are a spotted, hard-shelled species that are very destructive to the foliage of beans, especially in the Southern States.

Funnel Twisters, a species of Snout Beetle that rolls birch leaves into curiously shaped nests, resembling a funnel.

Hickory Borers are black beetles with thirteen yellow bands on their bodies. They girdle trees like the young sugar maples, and kill them.

Horn Bugs are American beetles that have curved horns on their heads.

Melon Beetles are twelve-spotted leaf beetles that eat into melons and squashes.

Oak Beetles, any one of several species of small boring beetles that make curiously shaped burrows into the wood of oak trees and there live in colonies with their young. They do much damage to timber.

Raspberry Beetles are red-necked, shiny beetles that infest raspberry bushes and leave something

on the berries that causes hard swellings, called "gouty galls."

Sugar Cane Borers are beetles that bore into sugar cane in the West Indies, making holes like shot holes in the joints. They also bore holes into wine casks.

We might go on and mention Tortoise Beetles, Sugar Cane Beetles, Cigarette Beetles, Whirligig Beetles, Scavenger Beetles, Squash Beetles, Snapping Beetles, Ham Beetles, Diving Beetles, Lady Beetles, etc., etc., etc. From all of this you may get an idea of what a great work it would be to try to investigate and in a measure to understand the vast number of insects classed as Beetles.

XIII.

FLEAS.

Fleas are wingless insects, belonging to the order *Aphaniptera* (from the Greek *aphanes*, hidden, and *pteron*, wing), of which over one hundred species are known. They belong to the class *Hexapoda*, meaning "six-footed," a class which comprises fully four-fifths of the animal kingdom. Dr. C. F. Baker, in 1895, listed forty-seven distinct species of Fleas in the United States. Besides the various kinds that live on animals, there are many varieties that hop about and frequent certain places. There are the Beach Flea, Sand Hopper, Shore-jumper, and Sand Flea; the Corn Flea, Bat Fleas, Porcupine Fleas, and Mole Fleas; the Plague Fleas, and so on. Fleas are strong biters and blood-suckers, and have a remarkable power in jumping; fleas can jump two hundred times their length. Their tough,

slick skins make it very difficult to crush them; they are very hard to catch. The common Human Flea, found on cats, dogs, mice, rats, gophers, badgers, and other animals, and sometimes on birds, is found in all parts of the inhabited world. The flea has two eyes, six long and stout legs, and feelers like threads. The piercing of the flea is done by its mandibles, and the upper lip has a sort of sucking tube.

Four different kinds of Fleas that are found on rats will bite man and will spread disease from rats to human beings. These troublesome little insects, carrying germs and spreading some terrible diseases, are yet possessed of a remarkable power of instinct. Prof. Steele says:

"Fleas have been trained to show their strength and skill. The so-called 'learned fleas,' exhibited at Paris, went through military movements, standing on their hind legs and shouldering tiny spears; two of them drew a companion in a little wagon and one sat on the coachman's box and used a whip. The spectators viewed this wonderful exhibition through large magnifying-glasses."

Fleas certainly are bold and energetic little insects. They are always on the hunt to suck blood from any animal they can alight upon. They show great determination and reckless regard for their lives. They are quick biters and suckers and quick and long jumpers. Shakespeare says in "Henry the Fifth":

"That's a valiant flea, that dare eat his breakfast on the lip of a lion."

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XIV. MOSQUITOES.

Mosquitoes belong to what is called the family *Culicidæ* (from the Latin *culex*, a gnat). The little insects which cause so much annoyance to man and animals are found in all parts of the globe. It is not a large group in this country. Dr. L. O. Howard names only five genera of Mosquitoes. In all probability there are about one thousand species of Mosquitoes; one hundred genera and seven hundred species have been listed by scientists.

The ordinary and widespread Mosquito lays its eggs, numbering from two hundred to four hundred, glued together, in a raft-like mass on the surface of water, standing in pools, barrels, ponds, or sinks. When the eggs are left undisturbed on the water for thirty-six hours, in warm weather, they will hatch out as many "wigglers," and the "wigglers" in a few days develop into full-fledged mosquitoes.

All mosquitoes pass through four stages of development: egg, larva, pupa, and imago. The male mosquito is slightly smaller than the female. The mouth-parts of females are made for biting. They have a set of needle-like stickers in their proboscis or trunk; with these they puncture holes in the skin of fruits to suck up juice, or pierce the skin of animals to suck up blood. When the female blood-sucker is in action (the hole in the flesh having been made), you will see her sharp needle-like bill working up and down like a drill and one limb moving at the same time like a pump handle. The male mosquito could not bite if he wanted to, This fact is true of

nearly all blood-sucking insects, like horse flies, etc.

The different kinds of mosquitoes and the harmful effects they bring are matters of great research. Volumes and volumes have been written, giving in fine detail the construction and the special work of all mosquitoes. The great swarm is vastly too numerous to attempt to mention in full. The following is a small partial list of some of the Mosquito swarm:

The Swamp Mosquito, a small black insect with white rings on its body. The Woodland Pool Mosquito, a large reddish brown kind, with white rings on its feet. The Fringe-legged Mosquito, a giant of the whole family. Its body is half an inch long and legs in proportion. Its legs have white bands around them, the body is black, and the bite something terrible. This species is also called "Gallinippers." The Spotted Swamp Mosquito, which carries in its body and in its mouth germs of malaria. The Cistern Mosquito, which conveys yellow fever germs. House Mosquitoes, which spend the winter in cellars, vaults, and damp, dark shelters of any kind, and are ready for an active campaign in the spring and summer.

The dengue fever, or "break-bone fever," an awful disease in India, is spread by a certain kind of mosquito there, which carries fever germs. "Sleeping sickness," a mysterious and deadly disease in Central Africa, is spread by germ-carrying mosquitoes and flies. The loathsome disease of leprosy is caused by a peculiar bacillus that in some unknown way gets into the human body. It has long been known that mosquitoes, flies, face mites, fleas,

and bed bugs help to spread this disease. "Dumdum fever" is spread by the bed bug of India.

THE POISON OF MOSQUITO BITES.

Macloskie, in 1887, demonstrated that the mosquito has a poison gland connected by a duct with its mouth, and after the insect drills into the flesh and begins to suck blood, this poison is injected and the swelling follows.

MOSQUITOES AS DISEASE-CARRIERS.

Time and again it has been thoroughly demonstrated by scientists that yellow fever is transmitted by means of the bite of a mosquito that has previously fed on the blood of those sick with this disease.

NATURAL ENEMIES OF MOSQUITOES.

Dr. L. O. Howard, chief entomologist of the United States Department of Agriculture, gives proofs of the awful spread of malaria by what he calls the "malarial mosquito." While man is everywhere a natural enemy of the mosquito and all sorts of devices are laid to destroy as many of the swarm as possible, yet it is interesting to know of the great number of fish that feed upon mosquito eggs and that catch mosquitoes. Howard names the sticklebacks, top minnows, sun-fish, and other fish that are mosquito-destroyers.

MOSQUITO WORK IN PANAMA CANAL ZONE.

Recognizing the great number of deaths in former years among laborers in the region of the Panama Canal, and scientists having thoroughly demonstrated the fact that a very large per cent of the

laborers died from the effects of mosquito bites, the United States Government, under the agency of the Panama Canal Sanitary Commission, began to exterminate mosquitoes when the work of digging the Canal was commenced. Anti-mosquito work was carried on by thousands of laborers in the zone, which is 50 miles long and 10 miles wide. The routine method was to brush, drain, and oil the whole area of a town or camp and its surroundings to a distance of 600 feet. Drain tiles and cement ditches with drip cans filled with a solution of sulphate of copper, constantly running. All pools holding water were oiled, all apartments of the laborers were screened, and all breeding-places of mosquitoes were filled with chemicals or oils that would destroy the eggs of the pest.

After spending many thousands of dollars on mosquito work and general methods of sanitation, the labor of constructing the Panama Canal was carried out without that fearful loss of life which had been the experience of the other Canal Commissions in years past.

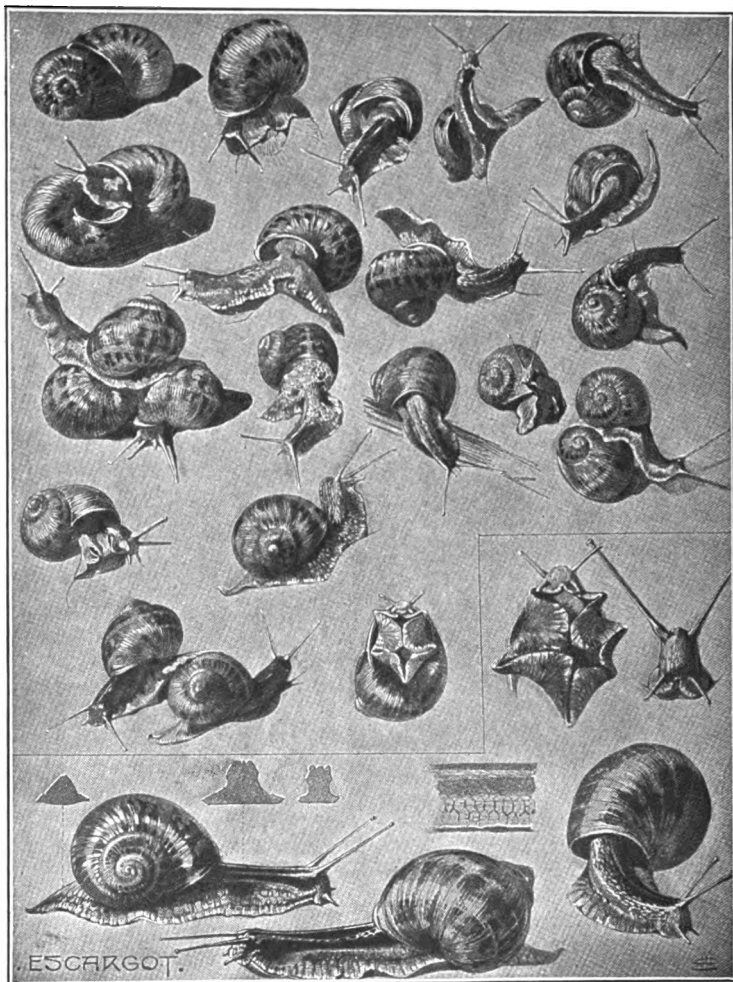
XV.

CORAL INSECTS, BARRIER REEFS.

Coral insects are the "silent builders of the sea." As on land millions of insects have their special work to do, so, far down beneath the wild waves of the ocean, the coral toil on, night and day, to build up islands. For a long time it was believed that the coral began working at the *bottom* of the sea, and brought their work on up, but now it is



CORAL ROCK FORMATIONS.



GROUP OF SNAILS.

From *Etudes d'Animaux*,
by M. Meheut, Paris.

Courtesy of Mr. Purd B. Wright, Librarian,
Kansas City Public Library.

(See page 108.)

Sea Blubbers are the largest known forms of the Jelly-fish. They are sometimes 6 or 7 feet across their bodies and have tentacles over 100 feet long. There are Milky Disk Jelly-fish, Speckled Jelly-fish, the Milky Cross, Thimble Jelly-fish, the Comb Jelly, and the Sea Walnut.

HYDROIDS.

To this class of sea life belong the *Hydroids*, which are bush-shaped marine animals with outward and upward extending tentacles. Hydroids fasten themselves on sunken logs, sticks, etc. The extending stem-like parts have mouths at the end of them, surrounded by rows of out-growing tentacles, which have minute cells in which, as in the Jelly-fish, are poisoned thread-like harpoons, coiled up, and which upon being touched are thrust out and into the object that molests the animal.

There are Passion Flower Hydroids, Eel Grass Hydroids, etc.; Swimming Bells, Hydra Tubes, etc.

SEA ANEMONES.

To-day the many-hued anemone,
Waving, expands within the rock-pools green,
And swift, transparent creatures of the sea
Dart thro feathery sea-fronds scarcely seen.
—*Sir Lewis Morris.*

Sea Anemones are keg-shaped sea animals that fasten themselves on rocks or other firm objects, under the sea water, or where the tide will pass over them. The keg-shaped anemones have slit mouths at the top, encircled by fringes of out-reaching tentacles, in which are cells containing coiled-up thread-like poison stingers, which they thrust into their

Fishes are divided into the following orders, with many subdivisions and families (Steele):

1. Double-breathing Fishes; as the mud-fish of tropical streams.
2. Strap-gilled Fishes, as saw-fish, sharks, sting-rays, and torpedo fishes.
3. Enameled Fishes; as gar pikes, sturgeons, spoonbill fishes, and lung fishes.
4. Bony Fishes; as fishing frogs, perch, puffer, snow-fish, cod, mackerel, archer, flat-fish, cat-fish, trout, flying-fish, herring, salmon, pickerel, gold-fish, eels, etc.
5. Pouch-gilled Fishes; as the lamprey, May-fish.
6. Gullet-gilled Fishes; as the lancelet.

SOME PECULIAR FISH.

There are many kinds of fish that, owing to certain things, are notably peculiar; some of these are as follows:

The Butterfly Fish, a dashing, highly colored swimmer, with broad wing-like fins, that darts about in the tropical seas.

The Cow Fish, a spotted fish that has two horns projecting over its eyes like a cow.

The Parrot Fish, a deep-green-colored fish with head shaped something like a parrot and having parrot-like jaws.

The Surgeon Fish, sometimes a poisonous species that belong in the waters of the East Indies. They have two long, sharp, movable spines that resemble a surgeon's lancet.

The Windowpane Fish, a very thin, broad American fish that is remarkable from the fact that objects on the other side of it can be seen through its body.

The Wolf Fish, a ferocious eel-like fish of the ocean, having large teeth and a wolfish-looking head.

The Hog Fish, a food fish of the West Indies and Florida, having a head resembling that of a hog. Some large specimens are poisonous.

The Drum Fish, a fresh- and salt-water fish that makes a noise under the water resembling the beating of a drum.

The Bellows Fish, a fish having a body shaped like a bellows and a long, double, bird-like bill resembling the handles of a bellows.

The File Fish, a fish having a rough, granulated scale surface resembling the surface of a broad file.

The Cutlass Fish, a long, thin fish with a sharp blade-like fin on its back resembling a cutlass.

The Paddle Fish, a long, thin fish with a snout that looks like a paddle.

The Schoolmaster Fish, a snapper of the West Indies that disciplines other fish and has great skill in escaping.

The Sail Fish, a fish having a sharp snout like a sword and a wide fin on its back that looks like the sail of a ship.

The Man-eating Fish (the Piranha) is a species found in South America. It is the most ferocious fish in the world. Theodore Roosevelt, in his article "Up the Paraguay," says:

"Piranhas will snap off a finger from a hand incautiously trailed in the water; they mutilate swimmers who bathe in waters where they are; they will rend and devour alive any wounded man or beast, for blood in the water excites them to madness."

We might go on noting the peculiarities of certain kinds of fish, but the list is too long.

We can scarcely touch the surface of this great subject. The "orders" widen and divide and subdivide into a multitude of fish life interesting to study; such as ribbon-fish, deep-sea shining fishes, moon-fish, sun-fish, devil-fish, angel-fish, bat-fish, blind-fish, bottle-fish, crawling fishes, drum-fish, file-fish, frog-fish, goggle-eyed fishes, ground fishes, lung fishes, parasite fishes, pen-fish, pipe-fish, poison fishes, sewing-fish, whales (the largest of the fin family), and many other fish forms. Dr. Jordan notes thirteen orders, over two hundred genera, seventy-five families, and over four hundred and forty species found in American waters. Vast and wonderful are the swarms of fishes that glide and dart hither and thither beneath the waves.

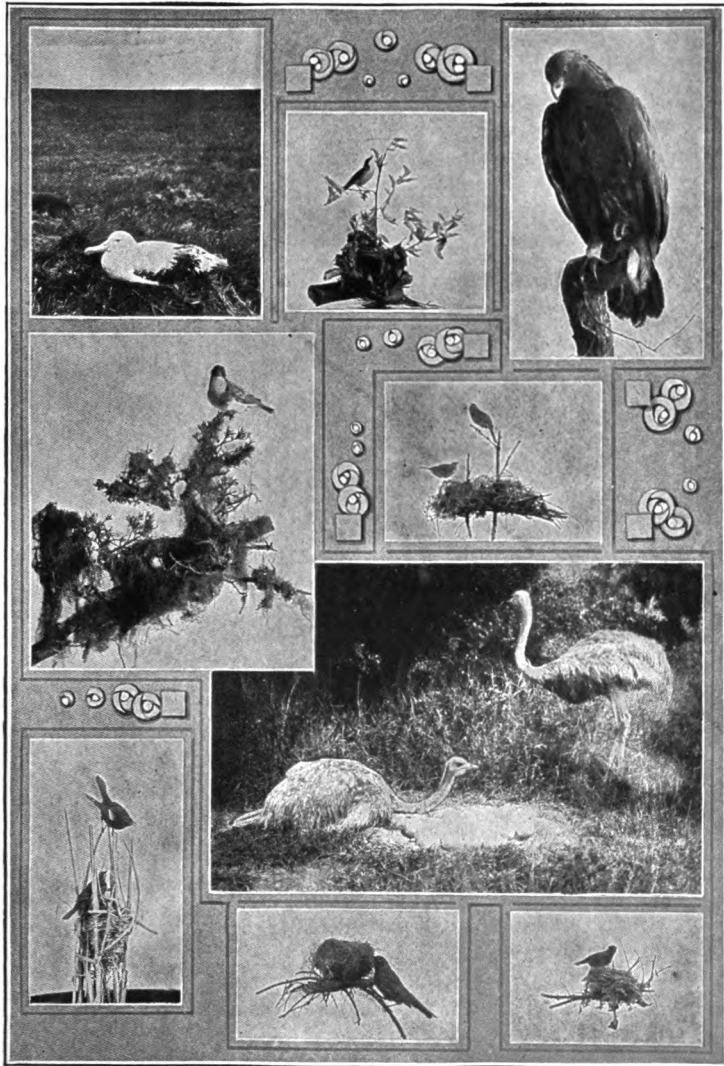
Whether we examine a heavenly body, the ocean, a mountain chain, a river system, members of the bird family, the endless productions of the vegetable system, or the fishes in the water, we hear from all of them a voice saying:

"In goodness and in wisdom He hath made everything;
Great and mighty are His works,
Glorious and magnificent the productions of His hands.
His works do praise Him;
They cry aloud from the earth, the air, and the sea."

XXIII.

BIRDS.

Ornithology (from the Greek *ornis*, a bird, and *logos*, a discourse) is a discourse on Birds, the science of Birds. The ornithologists, or scientific writers on Birds, are somewhat unsettled in their classification, some contending for several hundred genera



GROUP OF BIRDS.

and from ten thousand to eleven thousand species, whilst others claim the number is less. Dr. Packard says:

"There are probably from seven thousand to eight thousand species of living birds. Of the whole number, eight hundred and seventy-eight distinct species, or well-marked geographical races, inhabit North America, north of Mexico, and including Greenland."

Many systems of the classification of Birds have been proposed. The usual division consists of the following seven orders:

1. Order *Raptores*; Latin, *rapere*, to seize or to snatch.
2. Order *Insessores*; Latin, *insidere*, to sit in or down.
3. Order *Scansores*; Latin, *scandere*, to climb.
4. Order *Rasores*; Latin, *radere*, to scratch.
5. Order *Cursores*; Latin, *cursor*, a runner.
6. Order *Grallatores*; Latin, *grallæ*, stilts; *grallator*, one who runs on stilts.
7. Order *Natatores*; Latin, *natator*, a swimmer.

1. *Raptores*, *Birds of Prey*; such as eagles, hawks, vultures, owls. The typical members eat flesh; have great powers of flight, and keenness of vision; have large and strong feet with sharp curved claws, hooked bills, well-developed wings.

2. *Insessores* (an old classification), *Passeres*, or *Perching Birds*. This is by far the most numerous order, including seven thousand species and subspecies, or more than half of the Birds. It includes all singing birds, and, excluding birds of prey, all birds that habitually live in trees. In range of size, it includes from the smallest titmice to the ravens and birds of paradise.

3. *Scansores*, or *Climbing Birds*; such as the parrots, woodpeckers, cuckoos, trogons, toucans, etc. They have feet formed for climbing, have two toes pointing forward and two backward; as a general thing, they are not strong flying birds.

4. *Rasores*, or *Scratching Birds*; such as all domestic fowls (chickens, turkeys, Guinea fowls), pheasants, pigeons, doves, etc. They have large and strong legs; thick, short, arched bills; feet with the hind toe above the heel for scratching.

5. *Cursores*, or *Running Birds*; such as the ostrich, emu, cassowary, moas, and other long-legged birds. They have small wings, quite useless for flight; no keel to the breast-bone; hind toe wanting or rudimentary.

6. *Grallatores*, or *Wading Birds*; such as cranes, storks, herons, snipes, sand-pipers, etc. They have, in general, long slender bills, long legs without feathers, and toes often half-webbed.

7. *Natatores*, or *Swimming Birds*; such as ducks, geese, swans, sea gulls, etc. They have feet formed for swimming, generally webbed, toes connected by a thin membrane; hind toe elevated above the others; mostly flat bills.

Of all animals and moving life around and about us, none attracts more attention or is more capable of affording us real pleasure than birds. Their bright colors, their sweet songs, their lively manners, their remarkable instincts, have from the earliest ages made a strong impression on the minds of men, and given rise to many and peculiar notions about these winged creatures of the air and sky. The plumage of birds is a model of adaptation. The delicate filaments of the feathers are covered with grasping

barbs; the under side of the wing feathers is concave, to resist the upward pressure of air.

PECULIAR BIRDS.

Some of the peculiar Birds are: The *Butcher Bird* of Australia, that kills its prey by pressing them on thorns; the *Tailor Birds* of Africa and East India, that stick leaves together with long grass to support their nests; the *Bell Birds* of South America, whose notes sound like a bell; the *Australian Cat Bird*, that mews like a cat; the *Cow Bird* of North America, a bird continually flying about and around cattle; the *Cardinal Bird*, an American song-bird with a red top covering like a cardinal's cap; the *Coachwhip Bird* of Australia, whose notes resemble the crack of a whip; the *Dollar Bird* of Australia, which has silver-colored round spots on its spread wings about the size of a silver dollar; the *Friar Bird* of Australia, which is bald-headed and has peculiar notes like a chant; the *Frigate Bird*, an ocean bird with a spread of wings 7 or 8 feet, and a body of peculiar shape; the *Parson Bird* of New Zealand, remarkable for its mimicry, its black coat of feathers, and white feathers around its neck like a priest's collar; the *Rifle Bird* of New South Wales, which has a cry resembling the whizzing of a rifle ball; the *Secretary Bird* of South Africa, that has feathers on each side of its head like pens behind its ears; the *Snake Bird*, so named from its long snake-like neck; the *Umbrella Bird* of South America, that has a radiating tuft of feathers on its head, like an umbrella; the *Weaver Bird* of the East Indies and Africa, that weaves its nest out of grasses; the long-necked *Trumpet Bird* of South America, that has a prolonged cry like a trumpet.

On the tail of the bird is a gland containing oil, with which the bird oils its plumage whenever it wants to, and makes for itself a "mackintosh" or water-proof coat. The whole plumage is shed off gradually once, twice, or thrice a year. All birds lay eggs. The bones of birds are very light and hollow, but are possessed of great strength. The blood of birds is forced over the body by means of the heart, which has four chambers to it. The blood is purified in the lungs, just as in the human species, then distributed to all parts of the body; some even penetrating the bones. Birds can breathe through the end of a broken bone, even when the windpipe has been tied. It is supposed that the upward pressure of the air caught in the saucer-like hollow of the wing can not bend the inflexible bone and muscles of the front margin, but curves the ends of the elastic quills upward, pushing them forward, and so forcing the bird ahead. This is an explanation of how the bird flies. The bird manages this part with great ease, rising and falling, fast or slow, high or low, just as it wishes.

James Newton Baskett says:

"The birds form one of the five great groups of the Vertebrates, and of course their ancestry began when the back-bone was a gristly cord on the lower border of the fishes. Real bird life begins higher up still, where flight became special—not by skin, but by scales with some changes wrought in them. No creature but a bird ever flew by feathers. Nothing but a bird grows feathers. Why should not a man love a bird? If the palm of one should clasp the pinion of the other, there would come together two of the greatest instruments God and Nature have ever given any creatures to explore the world with."

BIRDS AS INSECT-DESTROYERS.

Since birds depend largely for their food on the insects that they can catch, it follows that birds are the farmers' best friend, as they catch and eat many kinds of insects that are injurious to crops. For example: crows eat white grubs, cut-worms, and meadow mice; tree swallows eat chinch-bugs; bank swallows eat weevils; pine siskins (California birds) eat olive scales and plant lice; killdeers eat mosquito eggs; nighthawks eat beetles and worms; grackles (Texas birds) eat cotton-worms; hawks eat grasshoppers; robins eat worms; thrushes eat beetles and caterpillars; chickadees eat ants, wasps, bugs, flies, grasshoppers, spiders, etc., etc., etc. The farmer and the orchardist realize of how much value their feathered friends are to them. As a rule, birds do not live very long, but they live fast.

FIFTY COMMON BIRDS OF FARM AND ORCHARD.

Bluebird,	English Sparrow,
Robin,	Crow Blackbird.
Russet-backed Thrush,	Brewer's Blackbird,
Ruby-crowned Kinglet,	Red-winged Blackbird,
Chickadee,	Bullock's Oriole,
White-breasted Nuthatch,	Meadow Lark,
Brown Creeper,	Horned Lark,
House Wren,	Bobwhite,
Brown Thrasher,	Black Tern,
Catbird,	Bobolink,
Mocking-bird,	Common Coon,
Myrtle Warbler,	California Jay,
Loggerhead Shrike,	Bluejay,
Red-tailed Hawk,	Arkansas Kingbird,
Cooper's Hawk,	Nighthawk,

Ruffed Grouse,	Flicker,
Upland Plover,	Yellow Sapsucker,
Barn Swallow,	Downy Woodpecker,
Purple Martin,	Yellow-billed Cuckoo,
Black-headed Grosbeak,	Screech Owl,
Rose-breasted Grosbeak,	Barn Owl,
Song Sparrow,	Mourning Dove,
Chipping Sparrow,	Killdeer,
White-crowned Sparrow,	Franklin's Gull,
Cardinal-bird,	Partridge.

XXIV.

THE REPTILES.

The Latin word *repere* means "to creep." From this we get the name "Reptiles," animals that creep. They all belong to the sub-kingdom *Vertebrata* (having back-bones). The study of reptiles, as well as all other animal life forms, has been of the deepest interest to nature-lovers. Before the time of Linnæus, a naturalist, who is called "The Father of Natural History," all the writers classified such animals as turtles, crocodiles, frogs, snakes, and salamanders as Oviparous Quadrupeds (that is, four-legged animals which lay eggs). Linnæus named such animals Amphibians, since they are at home either on land or in the water.

After this, French naturalists (Lyonnet and Brisson), observing that all such animals creep, gave them the name "Reptiles." Some other writers, seeing such a wide difference between frogs and toads and turtles and crocodiles, gave the name *Batrachia* (a word meaning "frog") to frogs, etc.,

and *Amphibia* to crocodiles, etc. Then still other writers classed all amphibious animals as Batrachians and the rest as Reptiles.

Reptiles are noted for having their bodies covered with scales and claws on the ends of their toes. This is not true of snakes. Snakes, instead of legs, have large scales on the under side of their bodies, by which the reptiles are enabled to glide along. Snakes grasp things, jump, swim, dive, and coil by muscular action on their scaled bodies.

There are five orders of extinct reptiles and four of living reptiles. The science of Comparative Anatomy has given the world all that it knows of these extinct forms. Bones found at different places were put together, and the animals or reptiles built up bone by bone. Many North American and European museums contain fine skeletons of extinct form of both land and water animals. Naturalists have now agreed that they should be classified into a series of orders, as follows:

EXTINCT REPTILES.

No. 1. Winged fish-like reptiles. Extinct marine reptiles with a whale-like body, four limbs (which they used as paddles), long tail, big head, powerful snout, large eyes, strong jaws, and many teeth.

No. 2. Beaked reptiles, crow-like. Extinct species of reptiles having large, powerful jaws, strong teeth, and four limbs (used for swimming).

No. 3. Huge lizards. Extinct reptiles of great variety of formation and structure; some adapted to life on land, some in water; some grass-eaters, others flesh-eaters.

No. 4. Bird-like reptiles. Extinct reptiles that

evidently had some power of flight, as the fore-legs were constructed to hold a kind of flap or membrane. They had large eyes, long jaws, strong teeth, big skulls; shaped like a bird.

No. 5. Lizard-like animals. Extinct marine reptiles with long necks, small heads, long tails, many teeth, whale-shaped bodies, and four limbs (used in paddling).

Crocodylia, including the groups of Gavials, Crocodiles, Alligators. Examples: Florida Crocodiles, Alligators.

Chelonia, including the groups of Tortoises, Terapins, Sea Turtles. Examples: Box Tortoise, Painted Tortoise, Hawk's-bill Tortoise.

Lacertilia, including the groups of the Iguanas, Slow-worms, Skinks. Examples: Marine Iguana, Glass Snake, Blue-tailed Lizard.

Ophidia, including the groups of the Colubridæ Snakes, Rattle Snakes, Harlequin Snakes. Examples: The Anaconda, Timber Rattle Snake, Coral Snake.

XXV.

THE CROCODYLIANS.

CROCODYLES, ALLIGATORS, CAIMANS, GAVIALS.

The Crocodylians (from the Latin *crocodilus*, crocodile) consist of Crocodiles, Alligators, Caimans, and Gavials or Crocodiles of India and Malay. They are the giants among reptiles—huge lizard-like creatures, coated with a rough armor of bony plates. Some of the family of the Crocodylians grow to be 25 and 30 feet long. Crocodiles have long spade-shaped heads,

with bulging eyes and lumpy noses, so that the head may lie level with the top of the water, yet they can see and smell. Behind each eye is a hinged flap to cover it. The tongue is so large that the creature can roll it back, forming a stopper to keep water from rushing down its throat when it wants to bite anything under the water. It has long jaws and two rows of teeth—large ones in front and smaller ones behind them.

Crocodiles have a pair of glandular sacs on their chins that contain a powdery secretion with a strong smell which they thrust out on the water at certain times, to find each other. Crocodiles hunt for their prey at night and during the day bask in the sun on sand-banks and on logs. They always keep their eyes shut, but they are not always asleep. It is one of their tricks to pretend to be asleep, so that they may snap up some animal that passes near enough to be caught in their ponderous jaws.

The largest members of the Crocodile family are the Gavials of India and of Borneo and Sumatra. These huge monsters of India grow to be 30 feet long. They are found in the Ganges and in the Brahmapootra rivers and their tributaries. The Gavials have long, flat, duck-like bills. The skull resembles a frying-pan, the snout looking like a handle. The Gavials of Borneo and Sumatra are over 15 feet long. All the family of Crocodilians are amphibious and have powerful tails. When swimming, the legs are not used at all; they are folded against the body, and the strong movements of the tail send the animal swiftly through the water. Crocodilians can not swallow in the water. They seize their prey in their great jaws and drag

it to some hole, where they let it decay, and they then eat it. At the approach of man, Gavials dash for the water and sink, but soon come up, showing their glaring tiger-like eyes. W. Carl Hagenbeck has captured several Gavials for "zoos" in different cities.

Raymond L. Ditmas, in his great work "The Reptiles of the World," has given a list of all the typical Crocodiles, dividing them into seven classes, as follows:

(A) Crocodiles with extremely long and slender snouts, extending from the head like the handle of a frying-pan. Examples: Indian Gavials, 30 feet long; Gavials of Malay, 15 feet long.

(B) Crocodiles with very sharp and slender snouts, which are triangular in outline. Examples: Sharp-nosed Crocodiles of West Africa, 12 feet long; Crocodiles of Australia, 6½ feet long; Venezuelan Crocodiles, 12 feet long.

(C) Crocodiles with snouts moderately sharp and distinctively triangular-shaped heads. Examples: Crocodiles of Florida, Mexico, Central America, and South America, 14 to 15 feet long; Siamese Crocodiles, 7 feet long; Crocodiles of the Nile, 16 feet long; Crocodiles of India and Malaysia, 20 feet long.

(D) Crocodiles with oval-shaped snouts, bluntly triangular. Examples: Madagascar Crocodiles, 30 feet long; Cuban and Guatemalan Crocodiles, 7 feet long.

(E) Crocodiles with short, broad snouts, triangular outline not well defined. Examples: Swamp Crocodiles of India and Malaysia, 12 feet long; Broad-nosed Crocodiles of western Africa, 6 feet long.

(F) Crocodiles with oval snouts, bluntly triangular. Examples: Rough-backed Spectacled Caiman and Banded Caiman of the upper Amazon, Central America, and tropical South America, length 6 to $7\frac{1}{2}$ feet.

(G) Crocodiles with very broad snouts; bluntly rounded at the tip. Examples: Round-nosed Caiman of tropical South America, $7\frac{1}{2}$ feet long; Black Caiman of tropical South America, 20 feet long; American Alligator, southeastern United States, 16 feet long; Chinese Alligators, 6 feet long.

The same author farther says: "Of the twenty-one species of Crocodilians, there are *but two* alligators; one inhabiting North America, the other the Yang-tse-Kiang River in China." Here is the way he puts the distinction between *Crocodiles* and *Alligators*, which has always caused much discussion among naturalists:

(A) Entire head broad; bluntly rounded at the snout (the Alligator).

(B) Head triangular; becoming very narrow towards the snout (the Crocodile).

So you see there is not very much difference between them, except in the shape of the head.

XXVI.

THE CHELONIANS.

TORTOISES, TURTLES, TERRAPINS.

The Chelonians (from the Greek *chelone*, a tortoise) include that great number of animals that are usually amphibious in their life (that is, able to live either in the water or on land), such as Tortoises,

Turtles, and Terrapins, of which there are forty-four species of the order in North America.

Tortoises and *Turtles* are classed as Reptiles. They are the best protected of all their kind, being encased in a shell formed of plates and firmly fixed to their back-bone and ribs. They have no teeth, but the rim of their jaws is covered with a hard skin full of little horns. The *Tortoises* have very strong muscles that draw up their jaws, and when they seize hold of anything, it is very hard to get it away from them. They have long necks and small heads. They can extend their heads out some distance from their shells by stretching, but draw their heads and legs inside their shells in an instant. Their eyes have three lids on them. *Tortoises* live on small animals and vegetables, but they have been known to pass months, and even years, without eating. If the case-covered reptile has short legs that have fan-like "flippers" at the end for swimming, then it is called a *turtle*; if the legs on the reptile are short and have claws on the digits, or finger-ends, then it is a *tortoise*. Most turtles and tortoises can live either on land or in the water.

TORTOISES.

Land Tortoises have feet for walking only. Their toes are short, five in front, four behind. They never go into the water, but often are found near to it. Some species are eaten in Europe.

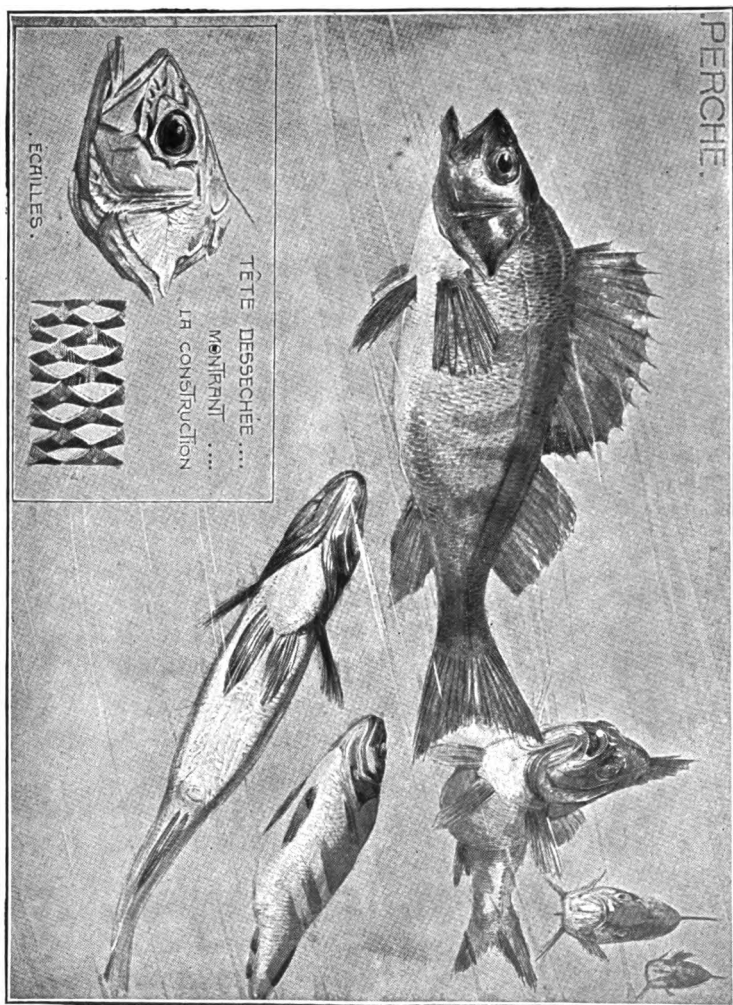
Mud Tortoises inhabit stagnant waters, at the bottom of which they love to bury themselves in the mud. Their flesh is much used for food in Greece and Italy.

XIX.

JELLY-FISHES, HYDROIDS, SEA ANEMONES,
STAR-FISHES.

JELLY-FISHES.

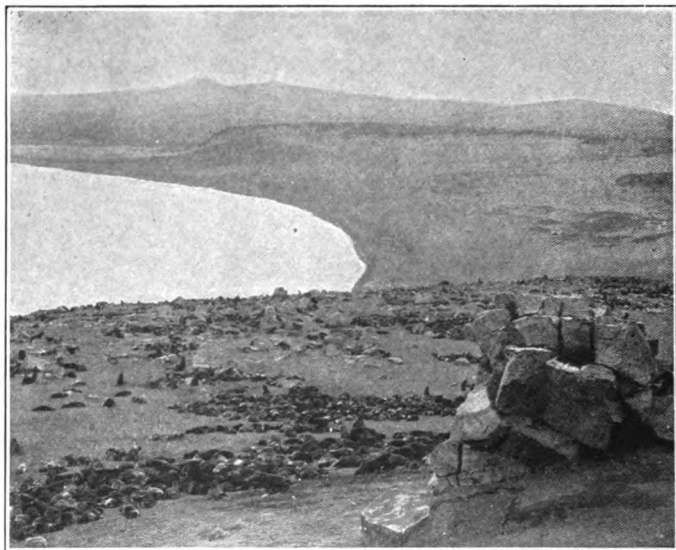
Jelly-fishes are raised umbrella-shaped gelatine creatures, with long swinging tentacles and with fringe-like sense organs on the outside of them. Through the jelly-like substance, which is translucent, there radiate sixteen blue canals; eight being branched and eight not branched. On the under side is the mouth, with four frilled lips, which have poisoned, stinging threads. The umbrella-shaped body has muscular fibers, and the jelly-fish breathe by expanding and then contracting these. They live on small fish and crabs, and sometimes on one another. Their tentacles swing out in all directions, searching for prey for their food. The tentacles are covered with a great number of minute closed cells, each one of which has in it a coiled thread-like weapon, which acts as a harpoon. When the cells on the tentacles are touched, they burst open, and the thread-like harpoons, which secrete a poison, dart out and stick into the prey. The poison quickly paralyzes such forms as small fish, etc. After the victims are paralyzed from the poisoned thrusts of the thread-like harpoons, they are taken up into the mouth by other long swinging appendages, that act as inner arms. The Portuguese Man-of-war is a beautiful form of this species of sea life. It is a highly colored pear-shaped animal, with a comb-like crest, long tentacles, armed with the celled harpoons, the sting of which benumbs their prey.



FISHES.

From *Etudes d'Animaux*,
by M. Meheut, Paris.

Courtesy of Mr. Purd B. Wright, Librarian,
Kansas City Public Library.



SEALS, ST. PAUL'S ISLAND, ALASKA.

Lions. The true Seals have been further subdivided by certain peculiarities in their teeth, as well as by the lack of ears. Some of the species are as follows:

- (a) Common Seal, found in North Atlantic and Arctic Oceans;
- (b) Harp Seal, having a crescent-shaped mark on the back;
- (c) The Bearded Seal, found on the British coast and the Greenland coast;
- (d) The Bristled Seal, found on the coast of Greenland;
- (e) The Flat-headed Gray Seal, found in the Baltic Sea and more northern waters;
- (f) The Crescent Seal, having a nose in the shape of a crescent, found in North America and Greenland;
- (g) The Elephant Seal, larger than any other, found in the Southern Seas;
- (h) The Small-finned Seal, or the Floe Rat of Greenland;
- (i) The Sea Leopard, a seal of the Southern Seas;
- (j) The Square Flippers, found around Labrador.

Seals are migratory in their habits, but usually they do not travel great distances. Their natural homes are either on land or in water. They spend a great deal of their time stretched out on rocks, sand-banks, ice-fields, or beaches. They have teeth which are particularly adapted to catching smooth and slippery prey. The chief food of seals is fish, but they will eat other animal food and part of certain vegetable substances. Seals breathe very slowly, the interval between each breath being about

two minutes. They can stay under water twenty-five minutes without breathing; this capacity greatly aids them in catching their prey. They catch different kinds of fish, mollusks, and occasionally snatch up sea birds found floating on the water. They are particularly fond of salmon. Their structure is such that they are perfectly adapted to life in water. They have very large and expressive eyes, adapted to land or to water. They have an awkward, shuffling, wriggling method of getting over ground—putting their fore-paws on the ground and jumping along. They are generally harmless, timid, inoffensive animals, but sometimes the old males have desperate fights, leaving great scars on each other.

Seals possess the five senses (seeing, hearing, smelling, tasting, and feeling) in great perfection. The Common Seal and some of the other species are very intelligent. They exhibit strong affection for their keepers, are fond of being petted and caressed, and readily learn their names like dogs. They can be taught to perform many amusing tricks. They are much affected by musical sounds. The Common Seal is 4 to 5 feet in length, and of a variable color, "though most generally yellowish gray, with spots of dark brown, black above and yellowish white beneath."

Seals are very valuable on account of their fur or hair, their flesh, their oil, and their skins. The fur is made into caps, capes, coats, and shoulder covers; the flesh is relished by the Arctic people; the oil is extensively used in lubricating machinery or illumination, the skins for boats, the intestines for gar-

ments, and the whiskers for fancy ornaments and ceremonies in Chinese houses.

The commerce in Hair and Fur Seals is immense. Hair seals are valuable on account of the oil they yield and their thick skins, which can be made into leather; fur seals are valued for their fur alone. Hair seals are generally entirely without a sufficient amount of under-fur to make them possess any commercial value. The principal Hair Seal fisheries are those of Newfoundland, Labrador, Gulf of Saint Lawrence, Jan Mayen, Nova Zembla, White Sea, Arctic Ocean, Caspian Sea, and North and South Pacific. Great herds of seals resort to the ice-fields of the northern regions to bring forth and to suckle their young. When the little ones are about six weeks old, they yield the best oil. The females are never killed. London is the greatest hair seal and fur seal market. Hair seal oil is valued for illuminating, lubricating, and for the finest grades of soap. The average number of hair seals captured annually is estimated at 875,000. Fur seals range in groups from south of the equator to the lands of the Arctic Ocean. The Pribyloff Islands, off the coast of Alaska, are by far the most valuable Fur Seal fisheries. The average number of fur seals captured in the world is 185,000 per annum. Nearly all fur seal skins are shipped to London, where they are plucked, dressed, and dyed. The average total value of both the hair and fur seals of the world is \$3,482,500.

One of the most noted places in our country where seals may be seen is upon the "Seal Rocks" at San Francisco. For a great many years several hundred otaries (or sea lions) have made three huge rocks near the entrance to the Golden Gate their

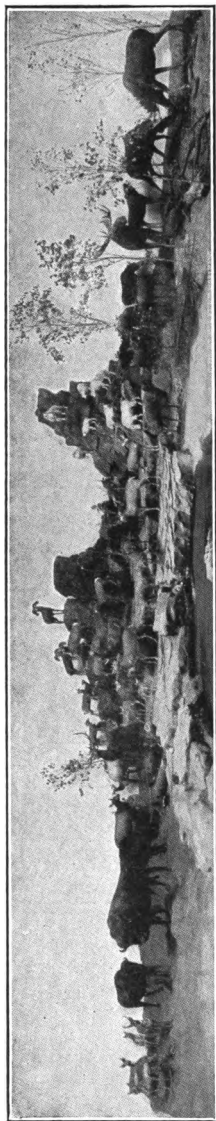
home or lounging-place. The breeding-grounds for this colony of seals is on the Farallone Islands, 24 miles distant. They make regular trips back and forth to those islands, bringing the little ones with them. Young seals take to the water three hours after birth, but have to be taught to swim by their parents. The little seals are covered at first with a kind of white fur, which drops off in time, after they have begun life in sea water. Quite a number of seals on the "Rocks" at the Cliff House have names; such as Ben Butler, William McKinley, Queen Victoria, William Jennings Bryan, etc., etc. Many of them weigh from 1,800 to 2,200 pounds. When the weather is cold and the sea is choppy, the seals at the "Cliff Rocks" remain in the water; but when soft and mild, they crowd the rocks full. It is a novel and interesting sight to watch the gambols and pranks of the sea lions on a warm day when they all feel good and want to play and slide down the rocks.

These curious sea animals have strange-looking forms and whiskered faces; their lives in the "kingdom of the sea" is limited by a fated environment—they are simply "links in being's endless chain"—an order of marine animals, filling a fixed and definite purpose in the great divine plan of Nature.

XXXII.

CLASSIFICATION OF ANIMALS.

The word *zoön* means "animal"; *logia*, "a discourse." From these words the term *Zoölogy* is derived, meaning "a discourse on Animals," or "the



MIDDLE SECTION OF MAMMAL EXHIBIT (DYCHE COLLECTION), NATURAL HISTORY MUSEUM,
KANSAS UNIVERSITY. (By permission.)
(Copyrighted by D. M. Horkman, Lawrence, Kansas.)

The picture shows only one-third of this vast collection of animals, in the display hall in the Natural History Museum. Lewis Lindsay Dyche came to Kansas from West Virginia in 1884. From 1890 to 1900 he was professor of Zoölogy in Kansas University. He has made twenty-one scientific expeditions, covering North America from Mexico to Alaska, including Greenland and the Arctic Regions.

The Dyche Collection is the finest and largest collection of North American mammals in the world. This picture was secured for this work through the courtesy of Chancellor Strong, of Kansas University. The collection was displayed in the Kansas Building both at the Columbian Exposition, in Chicago, and at the Louisiana Purchase Exposition, in St. Louis.

science of Animals." It is an old science, dating back to the Greek philosopher Aristotle, 322 B. C. He is called "the creator of natural science." "He was the first to divide the Animal kingdom into classes." Modern zoölogists have divided the Animal kingdom into twelve groups or *phylums* (meaning related groups, or groups which are believed to have a common descent). This classification is given by Parker and Haskell, in their Zoölogy, as follows:

Group I., *Unicellular Animals*, having only one cell; as the *Rhizopoda*, *Infusoria*, and three other classes.

Group II., *Sponge Animals*, a large group living mostly in salt waters, but a few in fresh waters.

Group III., *Coral Animals*, sea anemones, jelly-fishes and hydroids, or small animals that fasten themselves to rocks, sticks, and objects under water and catch their prey by reaching out with their many tentacles or arms.

Group IV., *Flat Worms*, consisting of four classes.

Group V., *Round Worms*, consisting of three classes.

Group VI., *Wheel-shaped Animals*, consisting of three classes.

Group VII., *Shell Animals*, a large collection divided into three classes.

Group VIII., *Shiny-skinned Animals*, always living in salt water and including seven classes; such as star-fishes, sea urchins, and their allies.

Group IX., *Ring-shaped Animals*, of five classes.

Group X., *Jointed-limbed Animals*, of nine classes.

Group XI., *Soft-bodied Animals* (most of them protected by shells), divided into five classes, in-

cluding such animals as slugs, snails, mussels, clams, oysters, whelks, limpets, cuttle-fish, etc.

Group XII., *Animals having notochords* (notochords are the beginning of back-bones). This phylum, or group, is composed of nine classes, the last five of which are fishes, amphibians (or such animals as frogs, toads, newts, salamanders, lizards, etc.), reptiles, birds, and mammals (or animals that suckle their young and are partly or wholly covered with hair).

J. Dorman Steele says:

"Man—the lord of the Animal Kingdom—is constructed after the same type as the cat which purrs at his feet; the ox which he eats; the horse which bears his burden; the bird which sings in his gilded cage; the snake which crawls hissing across his pathway; the toad which hides in his garden; and the fish which swims in his aquarium. All are modifications of *one* creative thought, showing how the Almighty Worker delights in repeating the same chord with infinite variations."

From this classification we see that man, the highest and grandest type of the whole Animal kingdom, "the lord of the earth," a being possessed of great intellectual and moral power, of an immortal soul, and who alone is declared to have been created "in the image of God," belongs to the class of Mammals. Zoölogists have placed him above all other animals in an order to himself, called the *Bimana*, the two-handed order, and in a separate family to himself, called the *Hominidæ*, the *family of Man*. From the class Protozoa to the class Mammalia there is an ascending scale of animal being, a constant development towards perfection, reached at last in the finished being—man.

To name and describe in detail the whole list of animals in their various classes would be to sketch

a vast number, which of itself would be far too great a work for our undertaking. We shall only mention a few of the classified orders, leaving the rest to be studied by you in the regular work in Zoölogy.

All animals are divided into two sub-kingdoms: the Vertebrates, including all animals that have partially formed and others perfectly formed back-bones; and the Invertebrates, including all animals having no distinct back-bones. Zoölogists have separated the whole Animal world into divisions, using the terms "sub-kingdom," "class," "order," "family," "genus," and "species." The distinctions between "classes" and "orders" are based upon certain particular things in the structure of the animals. (For example: whether they are flesh-eaters or grass-eaters, the shape of the tongue, the number and shape of the teeth, etc., etc.) This tabulation enables the scientist to fix the order of any animal at a glance. For example:

The Order Carnivora, the lion, tiger, puma, leopard, jaguar, domestic cat, lynx, wolf, wild cat, hyena, civet, genet, dog, jackal, fox, fisher, sable, weasel, the kinkajou, the serval, the glutton, the dingo of Australia, the fennec of Africa, the dasyure, the ferret, the ichneumon of Egypt, the mongoose of India, the coati, the cheetah, the chati, mink, skunk, badger, wolverine, otter, grizzly bear, black bear, white bear, raccoon, sea bear, sea lion, common seal, and walrus.

The Order Quadrumana, four-handed animals, animals whose feet are formed alike and who can use them both in climbing and in grasping; these are such as the orang, chimpanzee, gorilla, gibbon, sia-

mung, rhesus, saki, bear howler, lemur, graceful loris, all kinds of common monkeys, aye-aye, baboon, apes of all kinds, the potto (an African animal), the mandrill, sloth, drill, wanderoo, vervet, and the quakari (a peculiar monkey of South America).

The Order Ungulata (Latin, *ungula*, hoof), *hoofed animals*, includes such as the camel, giraffe, ox, horse, ass, yak, goat, sheep, gnu, musk ox, antelopes, chamois, gazelle, auroch, eland, moose, argall, caribou, addax, vicuña, proghorn, llama, ibex, rhinoceros, tapir, chevrotain, napu, muntjac, gemsbok, nilgai, okapi, dromedary, wapiti, peccary, wild boar, babboussa hog, common swine, all kinds of deer, buffalo, koodoo, alpaca, kanchil, and the daman.

The Order Proboscidea (from proboscis, a trunk or snout) comprises such animals as the elephant, tapir, shrew, etc.

The Order Marsupialia (from the Latin *marsupium*, a pouch) includes all animals that carry their young, some in pouches or bags of skin under their bodies (others carry them on their tails); such as kangaroos, wombats, bandicoots, opossums, koalas, and certain kinds of frogs.

The Order Edentata, *toothless animals*, are such as the giant ant-eater, the ai, the armadillo, the pichi-cago, and the aard-vark.

Every part of the world has some one or more classes of animals which predominate in kind. Australia has the pouched animals like the kangaroo; India has the greatest number of elephants; Egypt, the ichneumon and crocodile; Africa, the lion, giraffe, and hippopotamus; Asia and Arabia, the camel and the horse; the Arctic Zone, the reindeer, polar bear, and walrus; the Alps, the chamois, ibex, and

mountain goat; the Andes, the llama and the alpaca; Thibet, the yak; originally, North America, the buffalo, elk, deer, and grizzly bear, the panther, moose, wolf, fox, sheep, and beaver. The tropical regions contain the largest flesh-eating animals, such as lions, tigers, etc. Other large specimens, as the elephant, the rhinoceros, the hippopotamus, are found in warm regions. The largest reptiles, such as the crocodiles, the boa, the turtle, etc., are invariably found in hot countries. The largest birds, such as the ostrich, flamingo, peacock, and condor, inhabit warm belts. The temperate zone contains the ox, goat, deer, sheep, buffalo, camel, and other grass-eating animals. The arctic zone has a large number of the musk-ox, brown and polar bears, arctic fox, and many other kinds of heavy fur-bearing animals.

The general distribution of the animals is a great study. There are about 250,000 known species of animals in the world. The work of studying out and classifying these animals according to their zones of habitation has engaged the minds of the greatest naturalists. There are vast numbers and species of transferred animals. When we look backward through the ages, we find that many remarkable animals, now extinct, roamed over this old world of ours at different periods. Entire skeletons of such huge beasts as the mastodon have been found in many parts of Europe, Asia, and America.

Comparative Anatomy is that science which enables the student to understand the structure of animals so thoroughly that if he takes up just *one bone*, he can build up from *it alone* the skeleton and finally *name* the animal. If it were possible for comparative anatomists to find all of the missing

links in the Animal kingdom, what a wonderful revelation would be made of the stock of animals that have lived and died upon the earth throughout the cycles of the centuries!

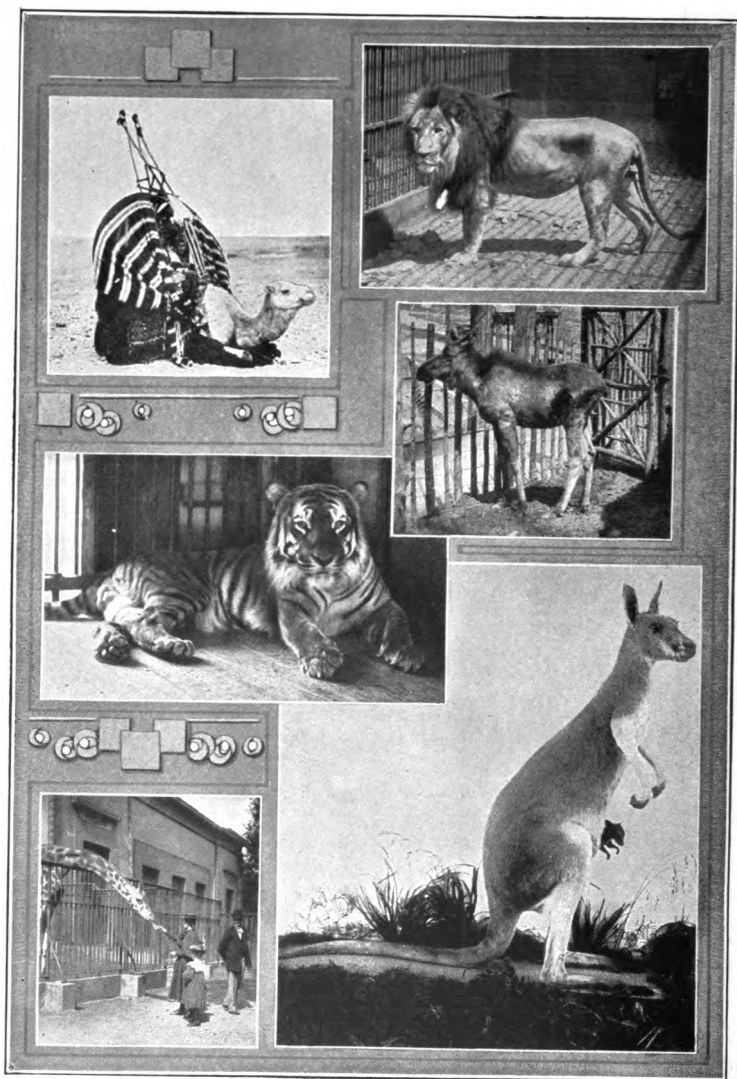
XXXIII.

THE LION, THE CAMEL.

THE LION.

The Lion stands at the head of the flesh-eating animals. On account of his prodigious strength, deafening roar, and ferocious nature, he is called "the king of beasts." He is the terror of all other animals on plain or in forest. His native haunts are the jungles and deserts of Africa, Arabia, Asia, Persia, and the dense pampas of the rivers of India. The lairs of lions are found in caves, mountain canyons, deep thorn-thickets, and solitary gorges. Sometimes lions are found in herds, but, as a general thing, they go in single pairs with a family of cubs. The lion's family is unbroken until the cubs are three years old. During the day the lion usually sleeps in his lair whilst the lioness looks after the cubs. When the night closes in, he prowls abroad in search of food for himself and family.

Lions subsist largely upon such grass-eating animals as the ox, sheep, goat, deer, zebra, horse, antelope, camel, and buffalo. As a rule, lions kill only when they are hungry or when attacked. They will attack any other animal except the rhinoceros. Their strength is remarkable. A full-grown African lion will carry off a cow, jumping ditches and fences, climbing rocks and steep places, until he reaches



The Camel.
The Tiger.
The Giraffe.

The Lion.
The Moose.
The Kangaroo.

his lair, where the lioness and cubs are waiting for food.

The Bible abounds in references to the lion. No other beast has been so much known or feared by man. Ferocious as lions are, yet, when taken young, they can be trained to do many things, and will show a considerable degree of affection for their keeper.

In ancient times great numbers of lions were provided for royal games and sports. The historian Suetonius says:

"Emperor Vespasian entertained the Romans with magnificent spectacles, and often in one day there were brought into the Colosseum many lions to entertain the populace by beast-fights."

THE CAMEL.

The Camel belongs to the order *Ungulata* (from the Latin *ungula*, a hoof), hoofed animals. This comprises nearly all the animals useful to man, such as the dromedary, Bactrian camel, llama, giraffe, musk ox, domestic ox, bison, buffalo, yak, zebu, mountain goat, chamois, gazelle, koodoo, ibex, gemsbok, mountain sheep, pronghorn, antelope, moose, reindeer, caribou, elk, roebuck, deer, fallow deer, musk deer, hippopotamus, domestic hog, wild hog, peccary, rhinoceros, horse, ass, and zebra. The Ungulates are divided by different family names into those having one toe, two toes, three toes, and four toes.

The camel is one of the oldest domesticated animals known to man. The Bible mentions camels in many places. For example, Job owned six thousand camels (see Job xlii. 12). King David in a

certain battle (see I. Samuel xxx. 17) captured or killed all of his enemies "save four hundred young men, which rode upon camels, and fled."

Camels are of two species, the Dromedary and the Bactrian Camel. Dromedaries have one hump, Bactrian camels two. Dromedaries are adapted to hot climates, Bactrian camels to cold climates. The camel is distinctively a beast adapted to desert life and to bearing burdens. The animal has broad cushioned feet which keep it from sinking in the sand. It has a hump on the back, which furnishes nourishment by gradual absorption should the animal go astray in the wilderness. The camel's stomach is divided into many cells, which will hold sufficient water to last a week; its nostrils, protected by hairs, close automatically on the first breath of a "simoon" or "poison winds" on the deserts; its eye is protected from the blazing sun by a double lid and an arch of bone, which acts as a curtain. When carrying burdens, the camel keeps its eye constantly on the ground, insuring sure-footedness; the under portion of the body of the camel and the knee-joints have hard, callous coverings on them, to enable the animal to fall on its knees to receive its load. Camels sleep with their legs drawn up underneath their bodies. Camel-drivers load their beasts while they are resting on their haunches, and sometimes, when the burden is heavy, the animals make a great deal of noise, groaning and uttering a peculiar cry of protest.

The camel is called "the ship of the desert." Its great strength, wonderful endurance, and gentle disposition have made it of invaluable service to man in traversing vast areas of deserts and bearing

goods and merchandise from point to point. It will carry from 600 to 1,000 pounds. A fleet dromedary will travel ten miles an hour for twelve or twenty hours on a stretch.

It is the Arab's chief source of wealth, and in Oriental countries to this day caravans consisting of hundreds of camels convey goods from one section to another. The camel has a long, swinging, jerking sort of trot that is very uncomfortable at first, and with many persons produces sea-sickness. Many years ago Senator Thomas H. Benton advocated the importation of camels into the United States for the purpose of bearing goods and merchandise across the vast deserts and plains of the great West. Ten camels were landed at New York, but they all died except one pair. These were taken to Nevada. They raised a family of twenty-four young, and these again increased to ninety-six, all of them descendants of the first original pair. It was not found practicable to use camels for the purpose of conveying goods across the plains, so the enterprise was abandoned.

XXXIV.

THE HORSE, THE DOG.

THE HORSE.

Some claim that the *Horse* was developed from a small five-toed animal—the process of evolution passing through ages. It is interesting to trace the ancestors of the Horse. This has been successfully done by great naturalists who have studied animal anatomy in the beds of fossil mammals found in

the western parts of the United States. Professor Marsh and others found the fossil bones of horses imbedded in successive strata of rock in Wyoming, and by means of building bone to bone they were able to describe the true Horse of the early periods. One is called the *Eohippus* (from the Greek *eo*, dawn, and *hippos*, horse), the "dawn horse." "The skeleton had *four perfect toes*, a fifth splint on the fore foot, and *three toes* on the hind foot." Another skeleton was of a species called the *Orohippus* (from the Greek *oros*, mountain, and *hippos*, horse), the "mountain horse." "It had *four complete toes* on its fore feet and *three* on its hind feet." There is another description of the fossil bones of a *three-toed* "desert horse," and still another of the fossil bones of the *Pliohippus*, or *one-toed* species of the Horse. How wonderful have been the discoveries in the fossil-bearing rocks! Louis Agassiz said:

"The crust of our earth is a great cemetery, where the rocks are tombstones on which the buried dead have written their own epitaphs."

The native country of the Horse is uncertain. However much the authorities may differ about the original home of this most valued animal, it remains a particular fact that the horse has always held a very prominent place in the history and minds of men. The very earliest records mention the horse. The Bible refers to the horse in very many places. When we think how dependent man has been upon horses, we can form some idea of the aid and service they have rendered. The horse has been a great factor in the world's progress.

The invention of automobiles and vehicles of different kinds which are propelled by electricity

has taken the place of horses, and in a great measure reduced the number formerly used in carriages, buggies, and wagons; but, however much these electric and gasoline vehicles may be used for street travel, pleasure driving, and the transportation of goods, there will always remain a work to be done by horses for which nothing can be substituted.

Domestic Horses are of many varieties and breeds. The horse is trained easily to perform any given sort of labor. He is an animal of intelligence, docility, and affection. Wild horses are found in many parts of the world. They are in central Asia, northern Europe, and on the plains of North America. There are many ways in which they are caught, but, of course, always by strategy. Horses have a keen insight into causes and effects, and seem to reason. They have been known so jostle and rub against apple trees in order that they might shake the apples off; to turn the tap of a water-tank so that they might get water; to open doors of corn-cribs to get corn; to open gates to get in and out; to unhitch reins and halter and go home; and to do many other things showing quite an amount of intelligence. The horse always has the spirit of his master. The race-horse knows what is expected of him, and he strains every nerve to pass under the wire first ahead of his fellows. The war-horse is wonderfully aroused when he hears the bugle and drum or the firing of artillery. The fire department horses know instantly the telephone alarm of fire calling their particular force, and they are almost uncontrollable till they get into their harness and are off for the fire; they can scarcely be held at all. The noble animals seem to know that they must put

their great strength to use to pull the hose-reel to the scene of destruction. Horses are wonderfully quick and intelligent in performing commands in artillery drills. Both artillery and cavalry horses are trained to perform some remarkable feats: jumping great ditches and hedge fences; lying down immediately, stretching out and feigning sleep at the sound of the bugle, and then, at another blast, jumping up. All sorts of tricks, such as walking lame, limping, high-stepping, bowing the neck, making bows, grimacing, and dancing, are taught to horses.

The horse is a grand animal, yet there are people who are mean enough to mutilate and maltreat the helpless creature: they will cut off his tail, thereby depriving the poor horse of his only natural protection against flies and other insects; they will put enormous loads on him, twice as much as he should draw; they goad his flanks with sharp spurs; they let him go unshod over rough and hard roads, bruising his feet; they rein him in such a way as to cut his mouth and strain his neck; they put cold steel bits into his mouth on a cold morning, blistering his mouth and tongue; they split his ears and put red-hot branding-irons on his quivering flesh; they drive him at break-neck speed on a cold, stinging day, and then let him stand and shiver without his overcoat. The officers of the Humane Society find many cases of cruel and vicious treatment of horses.

King Solomon evidently dealt largely in horses, and had a big stable of them. In I. Kings iv. 26 we find this: "Solomon had forty thousand stalls of horses for his chariots, and twelve thousand horsemen."

The anatomy of the horse is studied as is that of no other animal. Colleges all over the world are filled with eager students who learn all about the physical structure of the horse, so that they may heal wounds and save the lives of the much-valued animals. Horse doctors and veterinary surgeons are to be found almost everywhere. The diseases of horses are just as carefully studied as those of man, and in very many instances the same remedies are applied.

THE DOG.

The Dog holds pre-eminence over almost all other domestic animals. The very earliest mention made of dogs is to be found in the books of Moses, but their names are always spoken of with dislike and contempt. The Greeks thought a great deal of their dogs. In the ancient sculptures of the city of Nineveh and among the strange hieroglyphics of Egypt we find many dogs pictured in stone, showing that in a very early day dogs were held in very high favor.

The Bible is full of references to dogs. In I. Samuel xvii. 43 we find this: "The Philistine said unto David, Am I a dog, that thou comest to me with staves?" evidently showing that the mention of the word "dog" brought with it the idea of cruelty and beating. Job was not like Sir Walter Scott, who was so extremely fond of dogs; for Job says (xxx. 1): "Whose fathers I would have disdained to have set with the dogs of my flock." The good prophet Isaiah (lvi. 10) says (speaking of watchmen): "They are all dumb dogs, they can not bark." This must be of that brass dog and stone dog vari-

ety we often see in the yards of aristocrats—dumb dogs that can not bark. Even as grand a man as was David, "the sweet singer of Israel," was evidently afraid of dogs; for he says in the Psalms: (xxii. 16) "Dogs have compassed me." (xxii. 20) "Deliver my darling from the power of the dog." Lastly, King Solomon evidently knew something about the nature of dogs; for he says in his Proverbs (xxvi. 17): "He that passeth by, and meddleth with strife belonging not to him, is like one that taketh a dog by the ears."

Savage nations and tribes in all the world have always put a high estimate on dogs. The Indians of the wild plains, the Esquimaux of the frozen regions, all love their dogs. Cuvier makes the statement: "The dog is the most complete, the most singular, and the most useful conquest ever made by man." The many anecdotes and stories showing the superior intelligence of dogs would form volumes.

No satisfactory classification of the different kinds of dogs has ever been made. Hamilton arranges Dogs in six groups:

1. Wolf-dogs, including the Liberian Dog, Esquimaux Dog, Iceland Dog, Newfoundland Dog, Nootka Dog, Sheep-dog, Great Wolf-dog, Great St. Bernard Dog, and Pomeranian Dog.

2. Cattle-dogs, Boar-hound, Daniel Dog, Matin Dog, North American Indian Dog.

3. Grey-hounds, including the Pinjaree Dog, the Irish Hound, Lurcher, and Egyptian Street Dog.

4. Hounds, including Blood-hounds, Old Southern Hounds, Stag-hounds, Fox-hounds, Harrier, Beagle, Pointer, Setter, Spaniel, Springer, Cocker, Blenheim Dogs, Water Dogs, and Poodles.

5. Cur Dogs, including the Terrier and all his allies.

6. The Mastiffs, including the Bull-dog, Pug-dog, and Roachers.

Whilst this classification includes domesticated dogs, there is no telling how many different types of dogs exist among the wild races.

Whether we are ever able to know for certain the whole history of dogs or not, this much we do know about them: the faithfulness which all dogs exhibit to a very high degree is one of the qualities we expect to find in a friend. The dog has proven to be the friend of man. Dog history from the beginning until now is an unbroken record of fidelity. Senator George G. Vest, of Missouri, was once employed to represent a plaintiff in a law-suit over the killing of a very valuable dog. The plaintiff demanded \$200 damages. When Mr. Vest had finished his speech, the jury deliberated five minutes and handed in a verdict of damages. Following is the full text of the speech in which Senator Vest eulogized the fidelity of the dog:

"Gentlemen of the Jury: The best friend a man has in this world may turn against him and become his enemy. His son or daughter that he has reared with loving care may prove ungrateful. Those who are nearest and dearest to us, those whom we trust with our happiness and our good name, may become traitors to their faith. The money that a man has he may lose. It flies away from him, perhaps when he needs it most. A man's reputation may be sacrificed in a moment of ill-considered action. The people who are prone to fall on their knees to do us honor when success is with us may be the first to throw the stone of malice when failure settles its cloud upon our heads. The one absolutely unselfish friend that man can have in this selfish world, the one that never deserts him, the one that never proves ungrateful or treacherous, is his dog.

"Gentlemen of the jury, a man's dog stands by him in prosperity and in poverty, in health and in sickness. He will sleep on the cold ground, where the wintry winds blow and the snow drives fiercely, if only he may be near his master's side. He will kiss the hand that has no food to offer, he will lick the wounds and sores that come in encounter with the roughness of the world. He guards the sleep of his pauper master as if he were a prince. When all other friends desert, he remains. When riches take wings and reputation falls to pieces, he is as constant in his love as the sun in its journey through the heavens. If fortune drives the master forth an outcast in the world friendless and homeless, the faithful dog asks no higher privilege than that of accompanying him to guard against danger, to fight against his enemies. And when the last scene of all comes, and death takes the master in its embrace and his body is laid away in the cold ground, no matter if all other friends pursue their way, there by his graveside will the noble dog be found, his head between his paws, his eyes sad but open in alert watchfulness, faithful and true even to death."

XXXV.

EDENTATANS, OFFODIENTIANS.

THE EDENTATANS.

The Edentatans (from the Latin *edentatus*, toothless), the toothless animals, are scale-covered or hard-bone-covered; some are provided with huge scale-covered tails with pointed knobs called "tubercles" on them. They stand very near the bottom of the scale of warm-blooded quadrupeds on the earth. The Edentatans include the Armadillos, the Ant-eaters, the Tamanduas, the Sloths, and, until recently, the Aard-varks of Africa and the Pangolins of India.

The Armadillo (from the Spanish *armado*, armed) is a South American animal, having no protecting front teeth for biting. Their bodies are covered

with rings or bands of bony plates, with lines of loose hide between them. They have short legs, long plate-covered tails, sharp eyes, and sharp claws with which they can quickly burrow and hide themselves in the ground. They are swift runners. If an enemy approaches and they cannot get under the ground or run away, then they have the remarkable power of rolling themselves, head, feet, scale-joined body and tail, into a ball, leaving nothing exposed but a hard round shell. Hard as the shell covering is, the large pumas sometimes tear the shell plates off and devour the enveloped armadillo. From the fact that the puma of the forest is their deadliest enemy, the armadillos always live on the open plains. Armadillos are of four kinds: the Nine-banded Armadillos, the Six-banded Armadillos, the Three-banded Armadillos, and the Giant Armadillos, called Glyptodons (so named from their fluted teeth), a large extinct species of Armadillo, fossil remains of which have been found, showing the animal to have been 15 feet long.

The Ant-eater has already been described in part, to which we will state some additional facts. The Ant-eater has a very long, curving, slender, beak-shaped head, with its mouth and nostrils at the tip end. The opened mouth is about large enough to admit two of one's fingers. The animal had a very long round tongue, and *not covered* with coatings of a liquid gummy substance (as some have said), to which the little ants stick. It has a very large bushy growth on its hind part, ending in a large fleshy tail, covered with an enormous brush of coarse, waving hair. The tails are used to cover up the ant-hills (full of ants) when the animal finds the ants asleep. The animal has strong claws for dig-

ging and tearing open the ant-hills. The construction and adaptation of the parts in the construction of the ant-eater is wonderful.

The Scaly Ant-eaters (Manis) have scale-covered bodies, like the tiles on a house. They roll themselves into a ball when attacked by an enemy.

The Tamandua is a smaller Ant-eater than the ones just described. They have tree-climbing habits, having hands and tails which are prehensile, or grasp. Tamanduas are found in Venezuela, the Guianas, Brazil, and in the tropical forests on the North American continent south of Mexico.

The Sloths are tree-dwelling animals that hang by their hook-shaped feet from the branches of trees. They are covered with long, waving, coarse hair, much like the trees they stay in. Sloths are too large to live in a tree hole and not able to dig a hole in the earth, so throughout its life this queer animal spends its life hanging from the limbs of trees, and most of the time is asleep. In the earliest ages Ground Sloths of enormous size, creatures 18 feet long, lived on the wide pampas of South America and in the southern parts of the United States. These early Sloths are called Megatheriums, meaning "large beasts."

THE OFFODIENTIANS.

The Offodientians (meaning "diggers") include two families of animals: the Pangolins and the Aard-varks.

The Pangolins, of which there are seven species, those of India being fit types, are toothless animals, covered from the tip of the nose to the end of the tail with broad, flat, shield-shaped plates, arranged

on the body like shingles on a roof, or the scales on a fish. The scales are all controlled by the voluntary muscles of the skin. Pangolins have long beaks, and, like the Ant-eaters, to which they are related, live on ants. They have sharp claws for digging into ant-hills. When alarmed from any cause, the Pangolin quickly coils himself up on the ground and in such a curious way that no part of him is exposed—the whole body being a coil of plate armor.

The Aard-vark is another species of ant-eating animals with powerful front claws to enable them to dig into ant-hills. Aard-varks are found in south and east central Africa, in regions where the greatest number of tall ant-hills abound.

XXXVI.

MARSUPIALIANs, MONOTREMATANS.

THE MARSUPIALIANs.

The Marsupialians (from the Latin *marsupium*, a pouch) are pouched animals, or animals that have skin pouches, like outside pockets, under their bodies, in which they carry their young. They include eight families: the Kangaroos, the Phalangiers, the Wombats, the *Cænolestes*, the Bandicoots, the *Dasyures* and Tasmanian Wolves, the Opossum, and the Marsupial Moles.

The Kangaroo, the largest type of the pouched animals, is a native of Australia. They are yellowish-brown-colored animals, with very short front legs and very long hind legs, and a long, thick, heavy tail. The natural position of the kangaroo is to sit up on its haunches with its tail stretched out behind; its

short front legs are either folded up or are drooping against the sides of its body. The baby kangaroos are carried with their heads sticking out of the skin pouches of the mother kangaroo, and will not fall out when she takes long jumps on the ground; for, on account of the great difference in the length of their legs, kangaroos do not walk on all fours, but jump and hop along on their hind legs, holding their bodies in a position slightly inclined forward; in this way they go bounding from place to place. The long and powerful tail helps in the jumping, acting as a sort of spring-board to throw the animal forward. Kangaroos are quiet, inoffensive animals, but, when forced to fight, they protect themselves by striking out in a ferocious manner with their long hind feet, that are armed with long, sharp claws. When alarmed, kangaroos will jump from 25 to 30 feet to get away from an enemy.

There are many species of this queer animal: Rock Kangaroos, Hare Kangaroos, Potoroos, Brush Kangaroos, Pademelons, Wallabies, and Bettongs.

The Phalangers of Australia are fur-coated members of the family of pouched animals. They have prehensile or grasping tails. Some species of Phalangers have a thin membrane on the under side of their bodies, between the front leg and the hind leg, which they work like wings, enabling them to fly.

Wombats are burrowing members of the pouched animals. They have thick bodies, short legs, and toes furnished with powerful claws for digging in the ground. They are natives of Australia and Tasmania.

Cænolestes (meaning "robbers") are small pouched animals resembling rats, which are found in Ecuador and Colombia.

Bandicoots (meaning "pig-rats") are very large rats of India and Ceylon. They are relatives of the other pouched animal groups. They have long, sharp toes, with claws. They do much injury to rice-fields and gardens.

Dasyures (meaning "rough-tailed") are pouched animals much like martens. They have spotted bodies and tails, and are fierce enemies to all other small animals.

Tasmanian Devils are also related to the other pouched animals of Australia and Tasmania. They have coarse jet black fur, sharp claws, and are very savage and ferocious. They are great sheep-killers.

Opossums are American members of the pouched animal group. They are stout-bodied, coarse-haired, pig-like animals, with prehensile or grasping tails, having four kinds of teeth and hands especially, the ones on the hind leg with opposable thumbs like the human being. When caught, or even threatened with danger, opossums fall right down, stretch out, and pretend to be dead. The common saying, "playing 'possum," originated from this habit of that animal. Negroes in the South consider the meat of the opossum cooked with sweet potatoes to be a great food. The Opossum is not found anywhere else but in America. When the little opossums are very small, the mother opossum carries them in her pouch; but when they grow larger and still are not able to walk alone, she puts them on her back and they travel along clinging to her tail, which is curved over her body. It is a curious but not uncommon sight to see a mother opossum walking along in the woods carrying on her back six or seven young ones with their little tails coiled around her tail.

THE MONOTREMATANS.

The Monotrematans, the egg-laying animals, form a group which is the connecting link between the animals with back-bones and the birds. In fact, they are bird-like animals. There are but two families of the Monotrematans: the Duck-bill (sometimes called "the Water Mole") and the Echidna.

The Duck-bill has the bill of a duck and the body of an otter. Its fore feet have large saucer-shaped flaps extending from the ends of the five claw-shaped toes; these can be folded back under the foot when the animal wants to dig with its sharp toes, and then expanded again when it wants to swim. Its hind feet are webbed, with short extending claws like a duck. Its tail is broad and flattened. The body is covered with fur, which is a thick, soft wadding that water can not pass through. The animal burrows under the ground by a river bank, and has a warm nest or bed, made of dry grass, leaves, etc. There are two entrances to it—one under the water and the other above the water. Duck-bills are found only in Australia and vicinity.

The Echidnas (from the Greek *echidna*, a viper) are found only in Australia, Tasmania, and New Guinea. They are called "Porcupine Ant-eaters." They are about the size of a hedge-hog; the hair on their bodies is mingled with spines (resembling quills) on the upper side; the snout is long and tapering like a bird's bill; they have no teeth; they have five long claws on each foot, long tongues, and curious tails, resembling the tails of birds. The egg the female lays is covered with a leathery shell, and as soon as laid it is placed by the mother in one of the two large cheek-pouches in the sides of her mouth for protection.

PART IV.

XXXVII.

THE ROCKS.

Geology (from the Greek *geo*, earth, and *logos*, a discourse) is a discourse upon the Earth, the science of the Earth. It has been considered a fixed and certain science for about one hundred years. Before that time men did not have certain knowledge of the rocks, but now rock formations, shells, organic remains, and all parts of the Earth's crust are thoroughly understood. In the earliest ages men noted many curious things in rocks and layers of earth. They found sea shells miles and miles inland, buried in layers of solid ground. They observed the valleys, islands, peninsulas, and curious rock upheavals. The Egyptians, Greeks, and Romans noted these facts. One of the Greek writers (Ovid) claimed:

(a) The sea changes its bed. Sea shells found so many miles from the coast prove it.

(b) Valleys are cut and widened by running water, and the water-flow changes in its volume.

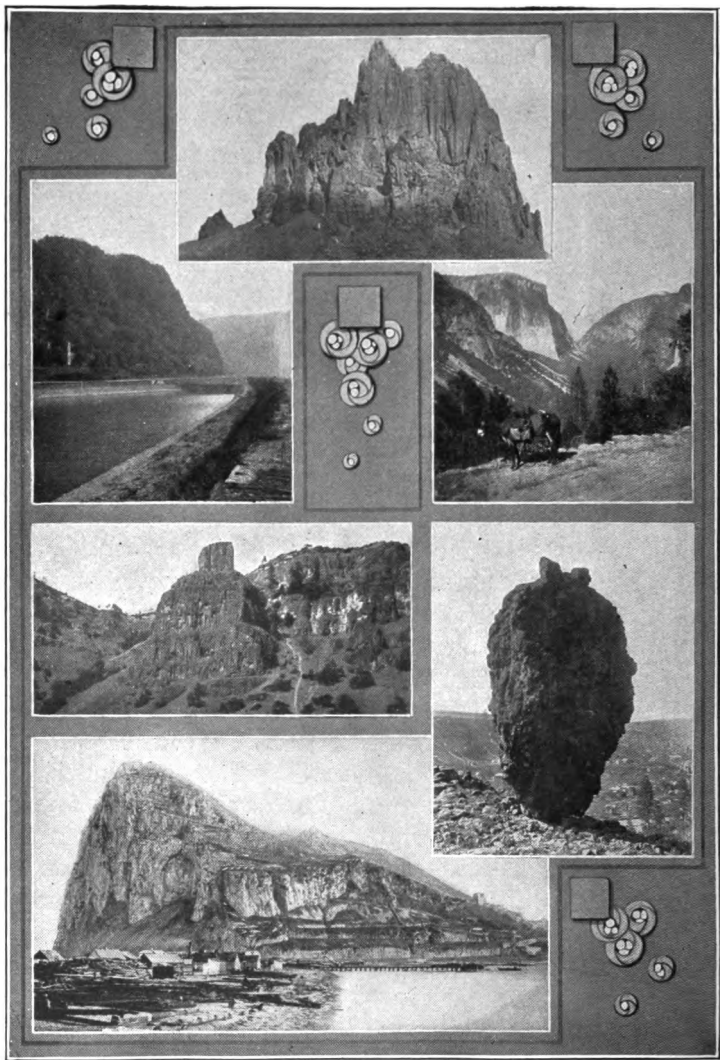
(c) Islands have been joined to the mainland by the growth of deltas and the shifting of the sea.

(d) Peninsulas have been divided from the mainland and made islands (like Sicily) from the changing of the ocean's bed.

(e) Some streams petrify or make rock of all substances that fall into them.

(f) The fire in the earth does not always escape from the same holes or vents (volcanoes).

Fossil shells, plants, and bones of extinct species



Rock of Lorelei. Ship Rock, New Mexico.
 Giant's Castle, Columbia River.
 Rock of Gibraltar.

"El Capitan," Yosemite Valley.
 Martha Washington Rock.

of animals found buried at great depths proved the fact that the whole physical and material earth changes. The theory of science is that our earth was once a globular mass of fire thrown off from the sun, and that its outer surface cooled and cooled, and by the influence of its surrounding atmosphere it finally, after a lapse of many cycles of centuries, became encrusted with a thin crust, upon which vegetation finally sprung, and the crust, thickening and thickening, became firmer and firmer, and changed at last into rock. The reason why rock layers are found so upheaved and irregular in form is because of the constant bursting through of volcanic fires at so many places and during the progress of thousands of years.

1. *Sedimentary Rocks.* Such rocks are found and formed below the current of a river, lake, or bay, where the water pressure holds all things (shells, plants, bones, gravel, sand, etc.) to the bottom and forms ooze, slime (sediment), which in time hardens and becomes rock.

2. *Igneous Rocks.* These are rocks upraised by volcanic action, as granite, trap, etc. Volcanic rocks, called "lava," are those thrown out in a melted or running state from volcanoes, as trachyte, porphyry, and scoria.

3. *Rock Changes.* Large masses of rocks become by different actions (volcanoes, glaciers, wear of water, heat of sun, freezing and thawing) stones. Stones become gravel (or "pudding stone"), and gravel becomes sand. Sand is powdered rock, and masses of sand form again into rock. When we look at vast deserts like the Sahara, Gobi, Mojave, or Yuma, we simply see what were once stupendous rock masses now pulverized to sand

The massing and hardening together of sand makes sandstone. "Conglomerates" are made of beds of pebbles, and shale is the hardening of thin mud or clay. The rocks are said to be the "leaves of the geological record," for they tell the "Story of Life on the Earth." Geologists have divided them into the following ages:

1. The age, or period, when the rocks show no trace of any living thing ever having been on them. "The age without life."

2. The age, or period, when the rocks show traces of life, such as fossils of shell-fish, seaweed, ferns, skeletons of fishes and of many reptiles.

3. The age, or period, when the rocks show the skeletons of birds, reptiles, and animals *with four feet* that lived both on land and in water.

4. The age, or period, when the rocks show a high order of vegetable life, plants, animals, reptiles, birds, and man, the highest animal in the scale of animal life.

As these different ages are subdivided into periods, the geologists know at once when a certain "rock formation" was made and the period to which it belongs: for example, rocks on the St. Lawrence River belong to the Laurentian Period (they are the oldest rocks on our continent). Rocks of the Cambrian Period show evidences of the very dawn of life. In some places they are from 20,000 to 30,000 feet in thickness, and their layers contain vast numbers of fossil remains, birds, flowers, reptiles, leaves, plants, worms, etc. Thus from the "Story of the Rocks" we get a deeper and clearer insight into that wonderful chain of life leading from the earth first as a blazing mass to its encrusted state, then its

deeper covering, and then to its solid formation over-spread with all the wondrous variety of field and forest.

HISTORICAL ROCKS, DOME-LIKE ROCKS, WATER-WORN ROCKS, PICTURED ROCKS, CURIOUS ROCK FORMATIONS, WIND-WORN ROCKS, SPIRE-SHAPED ROCKS, SHIP-SHAPED ROCKS, CATHEDRAL ROCKS, ETC., ETC.

The vast fields of Nature, all over the world, show many strange rock formations: queer-looking effigies that have been formed by wind and water, and towering masses, resembling all sorts of objects. There are many freaks and peculiar rock forms; they are found in nearly all lands. It is impossible to attempt to enumerate all of them, for they cover too vast an area of the earth. Some of the rocks stand out alone, and others in large groups. They form most interesting lines of Nature study.

The Rock of Gibraltar.—This famous rock, "The Lion Rock of Great Britain," because of its fancied resemblance in one way to a crouched lion, is the most celebrated coast fortress in the world. It bounds the Bay of Algeciras or Gibraltar on the east, and is between the Atlantic Ocean and the Mediterranean Sea. The stupendous rock of limestone mass is terraced on the west and south sides, but rises almost perpendicularly on the east and the north sides. It is 1,361 feet high. The ancient name of the enormous rock was "Kalpe," and the hills on the African side were called "Abyla," and together they were known as "The Pillars of Hercules." The great rock fortress has been held by Great Britain since 1783. It has withstood many

sieges, and has been occupied several times by different European nations. The rock is 9 miles back from the Strait of Gibraltar.

Another abrupt rocky mass is that of *Monte Pellegrino*, which rises northwest of the city of Palermo in Sicily. It is 1,968 feet in height. It has a cave or grotto, to which St. Rosalie, a Norman princess, about 1170 A. D., often went to spend her time in contemplation and in prayer, and to which the faithful make a pilgrimage once each year. The grotto is well described by Goethe.

Acro-Corinthus.—Overlooking the site of the ancient city of Corinth, in northern Greece, there is a huge rock, 1,886 feet high, called "*Acro-Corinthus*," upon the top of which there was a strong citadel, celebrated in history as the scene of many battles and sieges. Byron wrote:

"Many a vanquished year and age,
And tempest's breath, and battle's rage,
Have swept o'er Corinth; yet she stands,
A fortress formed to Freedom's hands.
The whirlwind's wrath, the earthquake's shock,
Have left untouched her hoary rock."

It was celebrated in Grecian mythology. There is a myth that the young warrior Bellerophon, finding the winged horse Pegasus, with a mane of gold, drinking at the fountain of Pirene, on the side of the great rock, put on him a golden bridle (a gift from the goddess Minerva), and, mounting the winged steed, rode through the air in search of the Chimæra, a fearful monster, a species of lion-dragon that breathed fire. The young hero at last found the terrible creature, and, swooping down upon it, killed it with his lance.

The Rock of the Lorelei is a great rock mass rising about 430 feet above the left bank of the Rhine. It is a famous place in legend. There is a story that a beautiful fairy used to dwell in the recesses of this noted rock, and by her sweet songs enticed many sailors and fishermen to come to the foot of the precipice in their boats. They were always drowned by the dangerous whirling rapids that swept around the base of the rock.

The Rock of Trichinopli.—Rising above the great plains in Tanjore, India, and the bushy forests of palms, a huge detached and lofty rock stands like a sentinel. It is 650 feet in height, and is a geological freak. Its sides are so smooth and slick that not a single plant can catch a chance to grow. The early settlers of India chose the summit of this rock as a place for their worship, and they hollowed out spaces so as to make galleries and stairways. Every night a sacred fire, which has been kindled for centuries, burns on the top of this rock.

The Acropolis.—The Acropolis at Athens, Greece, is a rock-formed plateau of crystallized limestone that rises precipitously about 600 feet above the level of the Mediterranean Sea. It is one of the most celebrated rocks in the world. On top of the rock stood the Parthenon, one of the most beautiful temples of ancient Greece; the ruins of its once splendid columns and walls are to be seen there now.

Ship Rock, in New Mexico, is a huge "skyscraper" that Nature built. It rises 1,690 feet from a desert plain. The gigantic rock resembles a four-masted ship in full sail. It can be seen for over 50 miles. It is the greatest natural monument in a

region that is full of tall, pointed, spire-shaped rocks, caused by the wearing of water and the pressure of wind.

Barrel Rock.—There is a remarkable rock formation 5 miles from Agua Caliente, Arizona. It is a mammoth rock, 300 feet in height, shaped like a barrel on top of a mountain. It can be seen for many miles and is called "Barrel Rock."

Independence Rock is a noted mass of granite, covering 40 acres, on the "Old Oregon Trail."

Dome-shaped Rocks.—There are many huge dome-shaped rocks to be found in different parts of the world. Some of the most striking forms of dome rocks are those in Yosemite Park; such as "Sentinel Dome Rock," "Half-Dome Rock," "El Capitan," and "Three Brothers." Rocks that resemble buildings, as cathedrals and synagogues, are to be found; such as "The Synagogue Rock," "The Castle Rock," and the chocolate-brown mass of rock rising over 400 feet from Green River, called "The Art Gallery." In Arizona stone minarets and rock spires, wind-worn and water-worn, and from 100 to 450 feet high, can be found by hundreds in the canyons of the Cliff-dwellers' region, such as the rock spires, "The Captains," in De Chelly Canyon. Another noted example of spire-shaped rock is the noted "Currecanti Needle," over 100 feet high, in the Black Canyon of the Gunnison River. There are two huge, strange-looking rock forms in "The Garden of the Gods" in Colorado, that are together called "The Gateway."

PICTURED ROCKS.

There are many masses of rock to be found that have on them such fantastic carvings, or water- and wind-worn places, that their surfaces resemble pictures and peculiar forms. Some of the most noted "pictured rocks" are those rising over 300 feet in height and extending about 5 miles along the south shore of Lake Superior, 40 miles east of Marquette. They have a variety of colors and their curious formations have caused certain masses of rock to be named; such as "Satan's Pulpit," "Old Mother Goose," "Happy Old Man," etc., etc. There are masses of fine "pictured rocks" along the Columbia River, and most remarkable formations in the St. Croix River and the "Dalles" of the Wisconsin River.

GLACIER-FORMED ROCKS.

There are many huge round rocks to be found at out-of-the-way places, standing alone, and their peculiar weather-worn appearance shows that at some period they must have rolled and traveled, grinding against other rocks, in some great glacial stream. These are such rocks as the "Elephant's Rock" and the "Potato Rocks," in Iron County, Missouri.

XXXVIII.

THE METALS

It has been difficult for scientists to give a general definition of Metals, covering all classes. One author says: "A metal is an element which, while

uniting with oxygen and many of the non-metals, especially the halogens, does not unite with hydrogen or with another metal, to form a true chemical compound." Yet this is faulty. The metals form the greatest part of the chemical elements, and all have certain characteristics in different degrees.

The Noble Metals.—There are nine metals usually called "Noble." They are: Mercury, Gold, Silver, Platinum, Palladium, Rhodium, Ruthenium, Osmium, and Iridium.

Metals vary in color. Silver and Platinum are white; Lead and Tin, bluish; Iron and Arsenic, grayish; Calcium and Barium, pale yellow; Gold, bright yellow; and Copper, red.

In hardness there is a wide difference. Steel scratches glass, while Potassium is as soft as wax. Bismuth is brittle, and may be crushed like glass, while Gold and Copper require an enormous force to pulverize them. Heat usually decreases the tenacity of the particles of most metals, but the more heat (up to 212 degrees) applied to Iron and Gold the stronger the particles hold together. Gold is more malleable than any other metal. A twenty-dollar gold coin may be hammered into a filmy leaf one two-hundred-thousandth of an inch in thickness. In ductility Platinum shows the wonderful property and ability of being drawn out into fine, hair-like wire, one thirty-thousandth of an inch in diameter. Iron will not melt until a white heat (2,786 degrees) is obtained. Mercury boils at 662 degrees. Iron and Steel are the most useful of all our metals. Cast-steel is made from cast-iron. Steel is often found, in a natural state, in meteoric stones.

Gold is the most valuable of all metals, and hence

the name "king of metals." Native gold is found either in rocks or along the shores of streams. Gold nuggets can be picked up in gold-producing countries, as Mexico, California, and Australia. Platinum is the heaviest of metals. It is used for money in Russia. Silver is found with lead. The lead is melted out and the silver remains. Metals, as gold, silver, platinum, and mercury, are often found combined or in their native state, while if they are found alloyed or mixed with each other, they form compounds, called "metallic ores."

The metals are generally distributed over the earth's surface, and are available (though sometimes by dint of great labor) by man. We have a wonderful variety of metal forms in this hemisphere. Michigan is the copper State, Missouri the lead and iron State, Colorado the silver State, and California the gold-bearing State.

There are sixty-four metals tabulated and known by chemists, beginning with Aluminum and ending with Tirconium. The chemists, instead of writing out the whole word, like Aluminum, put Al.; Chlorine, Clo.; Barium, Ba.; Hydrogen, H.; Mercury, Hg.; Gold, Au.; Phosphorus, P.; Platinum, Pt.; Sulphur, S.; and so on. These abbreviations are called "symbols."

Alloys are combinations of certain metals in given parts. Bronze is a mixture of copper and tin; Brass, a mixture of copper and zinc; Pewter, of tin and lead; Shot, of lead and arsenic; Dutch Metal, of copper and zinc; German Silver, of copper, nickel, and zinc; and so on.

Amalgams are alloys in which mercury is always found. Coins (gold and silver) are always alloyed

with copper to give them hardness. Pure gold (24 carats) is too soft to be of long service, almost like lead; therefore finger rings, brooches, watches, etc., are never made of pure gold in the general course of trade. The United States is one of the finest ore-producing countries in the world. Our great "bonanzas," such as Klondyke and Cripple Creek, and many others, attract the attention of the thousands that come to dig and mine for the precious ores.

We have five great mints in our country, where millions of dollars of metallic money are coined to supply the demand, both for home and for foreign trade. Yet there are untold millions yet unseen and unwashed within the canyons and mountains of the great West. The great ore deposits, like all the other departments of nature, show forth the wisdom and glory of Him who hath made all things well.

XXXIX.

THE RIVERS.

Rivers are mediums of Nature for carrying moisture off the surface of the land. About one-third of the water in the atmosphere finds its way back to the ocean through the agency of rivers. Rivers nourish and irrigate the countries through which they flow, as well as drain the lands of all impurities. Most of the great cities are built on rivers, and the best agricultural and commercial districts are in river valleys and in the midst of river systems. Rivers play an important part in the real development of the world. Formerly they were the chief means of travel and the veins of commerce, but

since the advent of railroads many of the river lines have been entirely abandoned. Rivers are of two kinds: Oceanic Rivers, such as empty directly or indirectly into the ocean; and Continental Rivers, such as do not empty into the ocean, but empty into inland lakes, into other rivers, bayous, marshes, or sink in the soil.

RIVER BASINS.

A great river, like the Mississippi-Missouri (4,382 miles long), has a great number of tributaries flowing into it, and the whole country traversed by the main river and its branches is called a "river basin." The Volga has the largest river basin in Europe, 520,000 square miles; the Obi, in Asia, 1,125,000 square miles; the Nile, in Africa, 520,000 square miles; the Murray, in Australia, 250,000 square miles; the Mississippi, in North America, 1,244,000 square miles; and the Amazon, in South America, 2,000,000 square miles.

The velocity or speed of a river depends upon the inclination and declivity of its basin. Winding streams usually have slow-moving currents. The Missouri River is a remarkably fast-flowing stream.

WATERFALLS.

A fall of one foot in two hundred and fifty makes a river not navigable, and forms waterfalls if the downward slope continues. Great waterfalls are made by deep and sudden declivities in rivers. The world's greatest waterfalls are:

Victoria Falls, Zambezi River, South Africa;
Laja Falls, Bio-Bio River, Chili;
Iguazu Falls, Parana River, on the Brazilian-Argentine border;

Kaiteur Falls, Potaro River, British Guiana;
Niagara Falls, water from Lake Erie;
Guaira Falls, Parana River, Brazil;
Great Falls, Missouri River, Montana;
Yosemite Falls, Yosemite Valley, California;
Shosone Falls, Snake River, Idaho;
Yellowstone Falls, Yellowstone River, Montana.

THE MOUTHS OF RIVERS.

If a river flows through high, rocky cliffs or mountains, it discharges its waters into a bay, lake, or the ocean by one deep channel; but if the coasts or banks are low and flat, it spreads out and forms what is called a "delta"; those of the Nile, the Ganges, and the Mississippi are examples. The river deltas of large rivers are themselves large in superficial area, and they are usually rich in alluvial deposits. Some deltas are very long and cover thousands of square miles.

FLOODS OF RIVERS.

All rivers are subject to either occasional or regular periods of overflow. The flood-time is due to heavy rains, melting of mountain snow, etc. In the tropics, the flood periods are either annual or semi-annual. The Orinoco, Ganges, Nile, and Niger have their flood-time in August; the Amazon, in March; the Mississippi-Missouri, in June. The periodical flood-tide of the Nile is the only source of real support or sustenance to the inhabitants dwelling along its banks.

RIVERS AND MOUNTAINS MAKE SLOPES.

In our country we have the Atlantic Slope, the

Pacific Slope, the Arctic Slope, the Mid-Continental Slope, and the Gulf Slope. Besides these five great general slopes, there are many separate and particular slopes, as rivers into other rivers, into lakes and bays.

LENGTH OF RIVERS

The longest river in Europe is the Volga, 2,400 miles; in North America, the Mississippi River, 2,960 miles; in Asia, the Yenisei, 3,400 miles; in Africa, the Nile, 3,776 miles; in South America, the Amazon, 4,000 miles; in Oceanica, the Murray, 1,060 miles.

SUBTERRANEAN RIVERS.

There are many subterranean rivers and lakes found in parts of the world, furnishing a water-supply, through Artesian wells, to districts that would otherwise be entirely void of water. The great system, both of overground and underground rivers, shows forth the wise economy of the plan of Nature. All is perfection, utility, and beauty. Ceaselessly the rivers flow, changing and interchanging their waters, some of them dry for seasons and then flowing again, some of them always high and full, some of them fast and straight, some of them slow and sluggish, some of them above and some below, but all of them filling an important mission. They are always active, always rolling onward, hurrying their waters away to their goal, the great ocean, where, in the process of evaporation, the water is taken up again, and by the winds and clouds borne to land again, and from the clouds come down torrents of rain, to again form rivers and streams, ever

flowing onward to the sea. It is a ceaseless motion, and is a sublime object-lesson to study in Nature.

XL.

THE DESERTS.

The word *Desert*, or *Sahara*, means "a solitary place." It is a barren, desolated, uninhabited land area. It is a vast ocean of sand, whose varying hues and colors are lost in the blue heavens. It is a wavy, moving mirror upon whose surface float fantastic pictures, caravans, lakes, trees, and a world of verdure. There is a silence in the desert, profound and deep, like that in mid-ocean, broken only by the roar of occasional simoons, cyclones, and "Santa Anas." Deserts are of five forms:

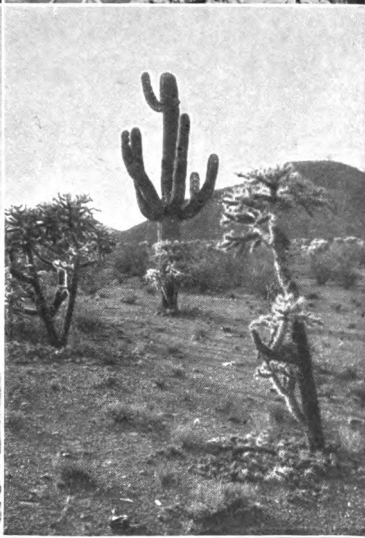
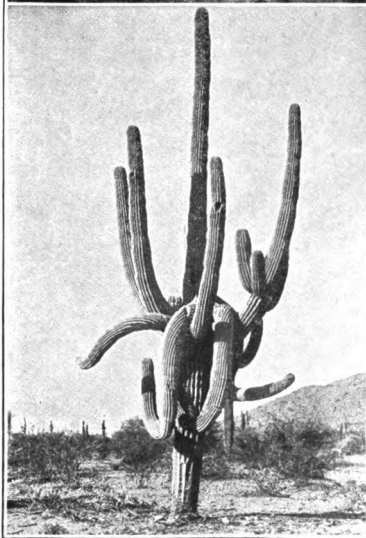
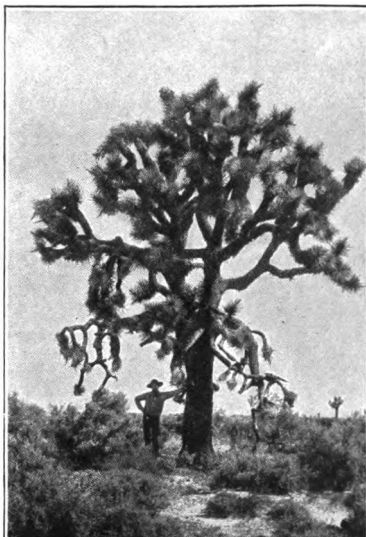
(a) Barren rocks, boulders, and snows on mountain ranges and elevated areas above "timber-line."

(b) Vast plateaus of ice and snow; as the ice plains of Greenland, the islands of the Arctic Sea, and, in fact, most of the Antarctic Continent.

(c) The lava plains in great volcanic districts where the sea is covered with scoriæ, destroying all life and vegetation; as in some parts of Arizona, South America, etc.

(d) Salt beds of extinct salt lakes and alkali ponds; as the deserts of Utah, Nevada, and Persia.

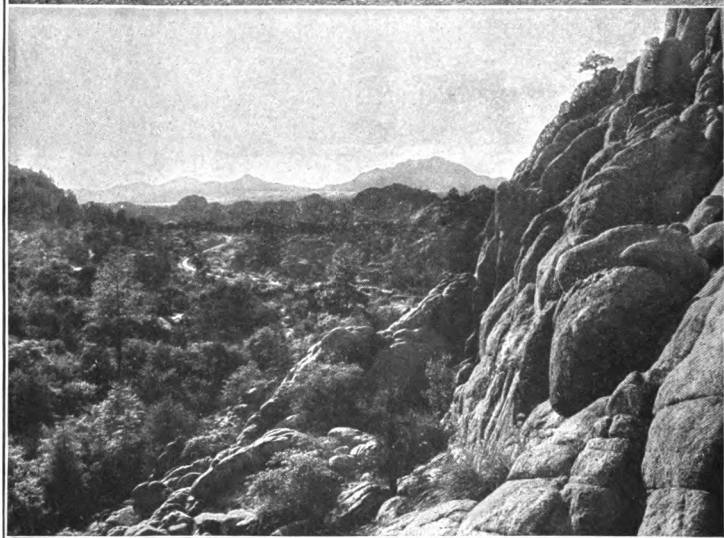
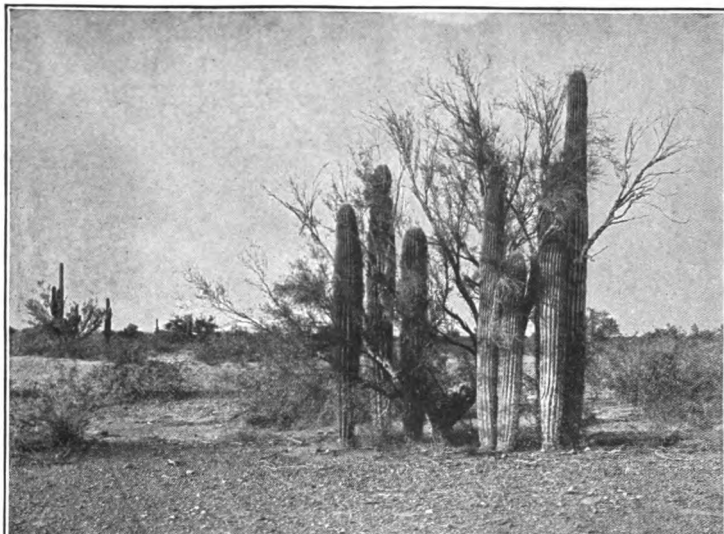
(e) Vast rainless, sandy areas; barren, dry, arid plains; as the Saharas of North Africa, the Libyan and Nubian Deserts over the peninsula of Arabia, the Gobi (or Shamo) Desert through Persia and Turkestan, the great Indian Desert in the Punjab, and the Kalahari Desert of southwest Africa.



Bush Tree Cactus.
Column Cactus.

"Gila Monster" of Arizona Desert.
Column Cactus.

Courtesy of Mr. Fred Harvey.



Cactus Trees in Arizona (above). Desert View from "Point of Rocks," Arizona (below).
Courtesy of Mr. Fred Harvey.

Deserts are found in many countries of the world. They are at all elevation *above* and depressions *below* sea-level, and on all varieties of surface. Sometimes they are vast mountain-encircled districts, rainless, waterless, lifeless—a vast flat expanse of sand; or, again, they are immense groups and chains of *sand dunes*, cones, hammocks, and hillocks, stretching far, far beyond the bounds of eyesight on every side. Deserts afford but few specimens of life and vegetation. There are only a limited number of hardy plants, like the manzanita, grease-weed, sage-brush, cactus, and certain varieties of Palm trees, that are indigenous to certain deserts.

True Cactuses (in the native state) are confined to American deserts. The Cactus plant is of two kinds:

(a) Bush-tree Cactus, growing in vast thickets and forests, sometimes 20 to 25 feet in height; the Glass-wort, the Kall-weed (which may be burned and made soda of), the Yucca, and Spanish Dagger.

(b) The Column Cactus, which is all body and no leaves. It has a wonderful capacity for holding moisture.

The three great desert beasts of Africa and Asia are the giraffe, the ostrich, and the camel; of America, the coyote, the prairie dog, the ground squirrel, and the jack rabbit.

The peculiar characteristics of Deserts are:

- (a) Their lack of water.
- (b) The great radiation from their surface.
- (c) The periodical appearance of sand-storms, simoons, whirling wind-storms, and rotating "Santa Anas."

- (d) The phenomena of the mirage; weather which is uniform.
- (e) Their strange wild desolation and gloom.
- (f) Their intense and terrible heat.
- (g) Their silence.

Deserts are, in a sense, the corpses of animated vegetable life—dead fields and cemeteries of Nature. They are formed from various causes. Those in Utah and Nevada were once the beds of extinct lakes and salt seas; while others are from the effects of volcanic action, and still others from long and continued fridity of climate.

The desert lands of the United States occupy 69,000,000 acres. They are distributed as follows:

Arizona (the Yuma and Arizona Deserts),
15,000,000 acres;

California (the Mojave and Yuma Deserts),
19,000,000 acres;

Nevada (the Humboldt and Nevada Deserts),
20,000,000 acres;

Utah (the Great American and Salt Lake
Deserts), 10,000,000 acres;

Wyoming (the Great American and Northern
Deserts), 5,000,000 acres.

The legal definition of *desert land* is: "All lands exclusive of timber lands and mineral lands which will not without irrigation produce some agricultural crop." This definition includes lands naturally suitable for grazing, as well as deserts in the usual sense of the word.

XLI.

THE ATMOSPHERE.

Webster defines it as "the whole mass of air surrounding the Earth," and it applies also to the whole mass of gaseous envelope of any other heavenly body, as the atmosphere of Mars, the atmosphere of Jupiter, the atmosphere of Neptune. It is a certain medium surrounding all heavenly bodies. The word "atmosphere" is from the Greek *atmos*, vapor, combined with sphere—"sphere-vapor" (it is akin to the Sanscrit word *atman*, breath, soul, and the Greek *atem*, breath), "sphere-breath," the breath or vapor of the sphere. It is what we breathe around us; absolutely necessary to our life. Our atmosphere is the great reservoir from which all air-breathing animals, birds, fish, insects, etc., get life. As one stands by the sea shore and gazes upon the rolling breakers and bounding billows, and listens to the ocean's mournful tones, he is impressed with the deep sense of its grandeur; but there is another ocean, the Atmosphere, which is boundless and shoreless, the great "upper deep," a world of air which everywhere surrounds the Earth and all the other planets, giving them food and nourishment. The science of Meteorology enables us to study the hidden secrets of the atmosphere, and from the patient experiments and investigations of meteorologists we have learned a great number of important and useful facts about the great enveloping ocean of air.

The Atmosphere is a mixture of gases and watery vapor. Two gases, oxygen and hydrogen, form the

bulk of its mass. In a mass of air there are twenty-one parts of oxygen to seventy-nine parts of hydrogen. Youman says:

"A very clear idea of these quantities may be gained by supposing the air throughout to be of a uniform density, and its elements separated into strata in the order of their weight. In such case the air would extend to the height of 5 miles. Its greatest quantity of watery vapor, if condensed, would form a layer 5 inches deep. The layer of carbonic acid would be about 13 feet deep, the layer of oxygen 1 mile deep, and of nitrogen 4 miles in depth."

1. *The air has weight.* This is shown from experiment and investigation. The pressure is in all directions, downward, sideward, and upward. The weight or pressure of the air (at sea-level) is 15 pounds on every square inch. This is called "an atmosphere"—60 pounds, 4 atmospheres.

2. *The weight of air is not the same at all times.* Winds and storms keep it in such motion all the time that it is being constantly condensed or rarefied (made heavier or lighter), so the pressure varies. On the tops of very high mountains the air has not the pressure as at the base of the same mountains.

3. *The variable pressure of the air* is measured by an instrument, called "the barometer." It is simply a glass tube, closely sealed and containing mercury, a thick, white-looking substance, which never freezes. The mercury is put in a bulb at the end of the glass tube (out of which the air has been taken), and when placed upright the fluid will rise or fall as the pressure is great or small.

4. *The pressure of the air upon the human body.* Upon a man of medium size, having a body surface of about 2,000 square inches, the atmospheric pressure would be about 30,000 pounds. The reason we

do not feel this enormous weight holding us to the earth is because the air within us presses outward with the same force. Fishes that go down in very deep ocean water have a pressure many times more than the pressure on our bodies. Yet they move about with perfect ease, because the pressure of the air is equally balanced.

5. *The boundary of the atmosphere.* Shooting-stars, or meteors, are supposed to be ignited by the compression of the air. If this be true, then the atmosphere extends many hundreds of miles outward from the Earth, reaching the boundary of other layers of other planets, all of which are believed to have certain and defined conditions of atmosphere fixed in the great law of Nature, but as yet imperfectly understood by man.

6. *The vapor in the atmosphere* has an important work in the vast economy of the plan. Over three-fourths of the weight of planets and animals consists of water, and they are constantly throwing off and taking in vapor and moisture. If the air were perfectly dry, the heat of the Sun would parch and burn everything to ashes. The vapory covering of the Earth protects it.

7. *Motion in the atmosphere.* Wind is air in motion, and may arise from any cause, but chiefly from changes in temperature. There are many general or periodical winds taking the nature of currents. Nearly all the perceptible movements of the air happen below the height of 18,000 feet. Violent winds are classified as: 1, Blows; 2, Gales; 3, Squalls; 4, Tempests; 5, Gusts; 6, Storms; 7, Hurricanes; 8, Typhoons; 9, Tornadoes. Winds produced by whirling or rotary motions of the at-

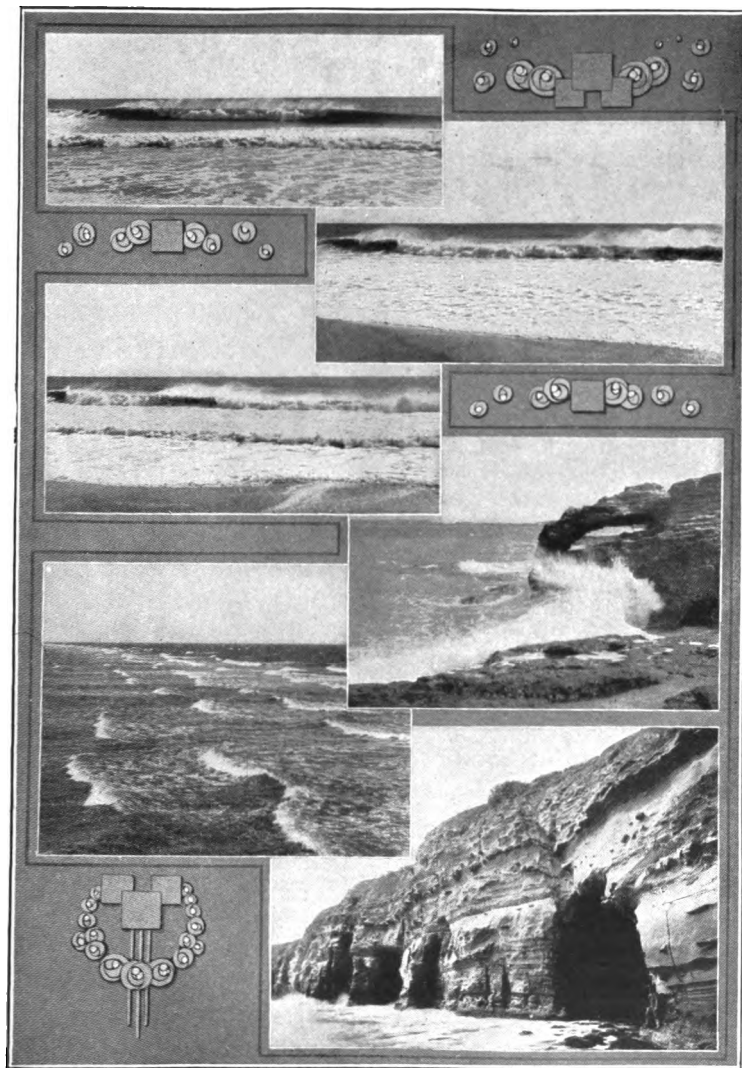
mosphere are about fifteen in number. The most to be dreaded of all is the "Cyclone," so common on this continent. We can not describe the various kinds of winds, such as Puna Winds (Cold Winds), Northers, Mistral, Bora and Black Winds, Paperos, Hot Winds, Siroccos, Trade Winds, etc., etc., in the limited space of this lesson. They should form a separate study to themselves.

XLII.

THE SEA.

The term "Sea" means that vast expanse of salt water covering the sunken portions of the Earth's surface, and which rounds out and completes its spheroidal shape. The illimitable body of water called "the Sea" is divided into oceanic, bay, gulf, strait, and sound divisions. It covers about three-fourths of the entire surface of the Earth (or some 144,712,850 square miles). It has an average depth of about 2 miles. The ocean water is very salty, and from its continual motion keeps, generally speaking, a uniform saltiness. If there is a great amount of evaporation along a long stretch of coast, and but little volume of water coming in, the ocean is saltier than where there are a number of fresh-water streams constantly pouring into it.

The principal ingredient of sea water is chloride of sodium, or common salt, mixed in with magnesia salt and pure lime. The temperature of sea water decreases with the depth. This is particularly the case in tropical regions; the deeper down the test, the colder the water is found. At great depths (as



Combing Waves.
Wind and Sea.
Breakers, Cape May.

Wind and Surf.
Rocky Coast, Bermuda Islands.
Rocky Coast, California.

5 miles) ice-water is everywhere found. The color of the ocean, when not mixed with muddy water from swollen rivers, animalcules, and foreign substances, is a pure, deep blue. The Red Sea is made so by the floating vegetable matter or organisms in it. The same thing is true of the Yellow Sea and of the Indian Ocean. The beautiful phenomenon known as "the sea's phosphorescence" is due to countless millions of invertebrate animals, whose beautiful forms, blending, gleam like silver and gold.

The motion of sea water has long been an object of great interest. It is always in a state of restlessness and motion, constantly swelling and rolling from point to point. There are, however, large areas of calm, sometimes for a considerable period, but this can not be said of the entire surface. Old-time sailors in sail-boats, especially on the great Pacific, dreaded a "calm" more than a storm.

The Sea has two motions: a vertical swinging of the waves, and a steady forward movement, a transference of a wave from one point to another—a wave slips, as it were, from off a rolling mass underneath and goes forward. The first motions of the waves are caused by the wind, or are caused by the strong and direct influence of the Sun's great heat, which produces evaporation and descending rain, and puts the waves out of equilibrium, thus giving rise to currents, which in their course finally become great rivers, veritable running rivers in the great ocean, having clearly defined color, differing from the rest of the ocean on each side, and running at a steady velocity from one part of the ocean to another.

These currents have various names; the *Gulf*

Stream being the one that a steamer must cross in going from New York to Liverpool. The air is warmer on the Gulf Stream than at either side of it; birds and fishes are found to frequent the Gulf Stream, not found in such abundance in other parts of the ocean. There is a perceptible change in temperature so soon as the ocean liner strikes the "Stream." Overcoats and mufflers (if it be summer) are not needed. It is one of the strange phenomena of the Sea.

The Kuro Siwo (Japan Current) is the main warm current of the Pacific Ocean. It flows northeastwardly from the island of Formosa to the western shores of North America.

When the great waves of the ocean come to shore and strike the low, flat banks of beach, they break and roll, boiling, foaming, tumbling, rumbling, and plunging to the shore. They are called "ocean breakers," or "the surf." Sea breakers have a loud sad and solemn roar, at times somewhat melodious, but generally deep-toned and measured. The roar can be heard at a long distance, and is one of the most mournful and solemn sounds to be heard. In these breakers persons bathe, and there is nothing in the line of bathing more exhilarating and pleasant. The striking force of ocean breakers is great, and unless one is accustomed to "taking a breaker" (as the bathers say), there is danger of getting hurt. Accidents frequently happen from this cause. The "undertow" is the strong under-current that breakers have to draw all objects out to sea. When the great rolling breaker comes plunging to the shallow shore, the wave "doubles under" and goes back, and is often very strong.

XLIII.

THE STARS.

The lovely stars, the forget-me-nots of the angels.

—*Longfellow.*

Our beautiful Earth is simply one of the vast host of revolving bodies in the heavens. It is called a planet. Surrounding it in every direction are Stars: fixed stars, revolving stars, shooting stars, filling the whole heavens, in constellations, so far away and out that they can not be seen by the strongest glasses thus far constructed by man. The whole number of stars is simply beyond any calculation. Astronomers estimate the number to be more than 100,000,000. We can only see about 6,000 at a time of the millions revolving in the world of space, extending every way outward.

COLORS OF THE STARS.

Some stars are red orange in color; some yellowish, some white, some bluish white, while others give us blue, green, violet, and other tints.

STAR CLOUDS.

Star clouds are great masses or clusters of stars so distant that they look like clouds. They are thousands in number, great nebulous clusters in the near and far-away heavens.

CONSTELLATIONS.

The Stars are divided into constellations, or groups, named from some fanciful resemblance to objects. Astronomers have now located and named ninety constellations.

"*The Milky Way*," visible all the year round, is a great zone of stars belting the earth, and extending outward into immensity. The number of stars in "*The Milky Way*" is estimated into the millions (about eighteen). In the center of this vast constellation is the Sun. Proctor calls it "the universe of stars." It is full of "Star Swarms."

THE DISTANCE AND MAGNITUDE OF THE STARS.

When we gaze upward and outward at the glittering hosts of the sky, their constant twinkling becomes a reason for curiosity and investigation. If we ascend very high mountains or ascend beyond the clouds in a balloon, the twinkling is less and the star brighter; so we conclude that the twinkling is due to the atmosphere and the changes in its power of refraction. We can form something like an estimate of the distances the stars are away from us when we know the measurements made of certain individual stars. Professor Bessel demonstrated that Star No. 61 in the constellation Cygnus is sixty-two and one-half trillions of miles from the Earth. The Sun is 91,000,000 miles away, and light travels to us in eight minutes, or 186,000 miles per second. At that rate, it took ten years for the light from Star No. 61 in the constellation Cygnus to reach the Earth. Stars are classified as follows: Fixed Stars (about 100 have names), Variable Stars, Temporary Stars, Binary Stars (double stars that revolve about each other), and New Stars. The magnitude of the stars ranges in classes from stars of the first to those of the sixth, ninth, fifteenth and sixteenth magnitude.

Glorious and majestic is this immensity of the starry heavens, and yet we are told that "He holds them in the hollow of His hand."

XLIV. THE SOIL.

Soil is that compound of earthy substance which covers parts of the Earth like a mold and gives nutriment and nourishment to plants. Scientific writers on Soil call this mold, or covering, the "*humus*," which Webster defines as "a brown or black material, formed by the partial decomposition of vegetable or of animal matter; the organic portion of soil." It is the loose surface covering in which plants grow, and is generally formed from decomposed or crumbled rock, mixed in with decayed organic matter. There are many kinds of soil, but clay, lime, and sand form the basis of all of them. Every kind of soil contains certain parts of vegetable and animal matter, either entirely or partly decomposed. The stratum or bed upon which the loose covering or soil rests is called the sub-soil, and it is almost without any organized matter.

KINDS OF SOIL.

The usual terms applied to the different kinds of soil are these:

Sandy Soil, a soil that contains about 70 per cent of sand, mixed with decomposed vegetable and animal matter.

Clay Soil, a covering that contains about 20 per cent of sand, mixed with decayed matter.

Limy Soil, a soil in which there is more than 20 per cent of lime, commingled with the necessary decayed elements of matter.

Loamy Soil, a layer that is composed of earthy

matter, either of clay or of sand, just enough sand being in the mixture to keep the clay from "sticking." There are sandy loams, clay loams, lime loams, and vegetable loams.

Marly Soil, a mold or covering in which the earthy crumbled deposit consists of clay mixed with about 20 per cent of lime.

Alluvial Soils are soil-coverings formed by the washings of streams. They contain every kind of soil washed by the streams; they are usually loamy and are very rich and fertile. Soils made from decomposed or crumbled rocks are called "*sedimentary soils*"; those formed from rocks above them and carried to them are called "*transported soils*"; those carried by the action of glaciers are called "*drift soils*"; and those formed from running water are called "*alluvial soils*."

Soil-making is going on all of the time; good soil is largely composed of decayed plant life; the leaves, blossoms, buds, nuts, and grasses that decay are all rich soil-makers. The worms and all animals that tunnel through the ground help to make soil too; for they make holes in the ground, which are channels for water, and the moisture nourishes the soil particles. Farmers plow up the ground and harrow it, so that, by stirring up the soil, the water can soak into it and make the particles more fertile. Soils may be embraced in two classes: heavy soils and light soils. Heavy soils are those which absorb water easily, are porous, and they are soft when wet and hard when dry. Such soils are usually deep and black, frequently called "gumbo" land, and are very fertile. Heavy soils require more labor to pulverize the clods and to till the

ground than light soils. They can not be ploughed when they are very wet, nor easily when they are very dry.

Lands may be divided into "timber lands" and "prairie lands," and these subdivided into "uplands" and "bottom lands." The "bottom lands" are again divided by farmers into "*high* bottom lands" and "*low* bottom lands." High bottom lands *are not* subject to overflow. The soil is porous and sandy and very fertile. Low bottom lands *are* subject to overflow, and are not well suited for cultivation unless they can be thoroughly and successfully "diked" and protected from inundation. "Swamp and cypress lands" are of this variety, and, being covered with water for most of the year, are unfit for cultivation.

Certain kinds of plants and tree growth indicate certain kinds of soil; for example: heavy sumach bushes, brown mulatto soil good for wheat; hackberry trees, good soil for corn, oats, wheat, fruit, blue grass, and clover; elm trees and resin weeds, good soil for all staple crops, very fertile; white oak trees denote thin soil, yet with good sub-soil such soils with good cultivation produce all the staple crops, fruit, grapes, tobacco, and grasses; post oak trees and black jack trees indicate thin soils, yet with proper care vineyards thrive upon them; pine trees indicate thin soil, best adapted to such vegetables as sweet potatoes; walnut trees indicate deep mulatto-colored soil, fine for wheat and other grains, as well as tobacco.

Some surfaces on the earth are very deceptive as to the real richness and character of the soil underneath them; for example, the soil of San Joa-

quin County, California, is in general a vast area, sandy, unfruitful, and unhealthy-looking, yet underneath that gray dusty exterior is a deep rich soil that produces most wonderful crops of wheat. The same is true of many other sand-covered regions. *Peat Soils* contain large quantities of weedy and decayed vegetable matter; they are fine for Indian corn, broom corn, barley, potatoes, and turnips.

The Fruitfulness of Soil is increased and also decreased by a fixed law. Every crop taken from a field of land removes with it a certain amount of the natural elements (potash, lime, magnesia, etc., etc.) in the soil; therefore it is necessary for the successful farmer to nourish and feed his land when he discovers that, from cropping and re-cropping with the same growth, the land is becoming weak; in other words, "the farmer must feed the land which feeds him." He must rotate his crops and strengthen weak-producing soil by all the modern remedies.

XLV.

WEEDS.

A man of words, and not of deeds,
Is like a garden full of weeds.

—*Old Saying.*

"A weed is a plant growing in cultivated ground to the injury of the crop or desired vegetation." (*Webster.*) "A weed is a plant not wanted." (*Bailey.*) "A weed is an unsightly, useless, or injurious plant."

NATURE OF WEEDS.

Weeds are wild plants that are strong and persistent in their methods of injury. They grow every-

where, on cultivated and uncultivated ground. They easily outclass all other forms of life, growing from out of the ground, in their power to weaken the fertility of soil and to destroy the life of other plants.

Weeds are natural-born warriors. They are everlasting campaigners and besiegers. No place nor spot of ground on the earth is safe against the world's wild army of weeds. We often hear people say: "The weeds are taking the place." The fact is, weeds *take all places* unless there is a most vigilant, determined, and unceasing warfare carried on against them. Sometimes we have heard folks say: "The weeds are as tall as a horse's back;" "The weeds are as high as your head;" "The weeds are as high as the fence." And all these sayings are often found to be true. Wherever weeds have an unrestrained chance to grow and spread themselves, they certainly do make a great showing.

Weeds are Vandals and despoilers in the fields of Nature. They subdue all forms of vegetable life. Farmers sometimes speak of having a "poor stand" of corn. Nobody ever heard anyone speak of a "poor stand" of weeds. Weeds don't make a "poor stand." They are strong, bold, active, and determined plants, that live through everything and stand all climatic conditions and flourish where other forms of vegetation will die. Weeds do not need to be cultivated—they just come up and grow; as soon as the little weeds get their heads above the ground, they begin their battle against all other plants. If they are cut down, they drop their seeds on the ground, and soon a whole family of warrior weeds spring up from the earth, and, like the armed men in the mythical story, which sprang from the ground

when Jason sowed the dragon's teeth, they spread in all directions to reinforce their comrades.

Weeds are repulsive. We never find any nice or pleasant things said or written about weeds. People speak of them as the *abominable* weeds, the *ugly* weeds, the *hateful* weeds, and so on. They get nothing but abuse all the time; yet even the weeds have their part in the great plan of the Vegetable kingdom.

CLASSIFICATION OF WEEDS.

There are countless thousands of weeds; they cover the whole earth. They form a vast space in the life which springs up from and grows from out of the ground. Weeds, with reference to their duration, may be classified as annual, biennial, and perennial. The list is far too long in each class to give many from the vast number of noxious weeds. Some of the most conspicuous annuals are: mustard, nightshade, foxtail, orach, pepper weed, cocklebur, plantain, pigweed, purslane, ragweed, Russian thistle, Western senna, shepherd's purse, wild barley, smartweed, Spanish needle, spear grass, sunflower, and velvet weed. Some of the noted biennial weeds are: oyster plant, wild parsnip, primrose, mullein, sweet clover, teasel weed, and bull thistle. Perennial weeds are: needle weeds, nettle weeds, nut grass weeds, wild onion, milkweed, garlic, hawkwood orange, horse nettle, ox-eye daisy, water parsnip, poison ivy, dock weed, common plantain, dandelion, red top, sheep sorrel, silver weed, sow thistle, sneezeweed, Star of Bethlehem weed, St. John's wort, switch weed, and weeper trumpet weeds.

MIGRATION OF WEEDS.

Weeds, like human beings, in their migration follow certain routes of travel. Most of our weed plants are "foreigners." The pigweeds, jimsons, and morning glories came from Central America; water weeds are from Ireland and Scotland; horseradish, mustard, and wild hemp are from Asia; the sow thistle is from Australia; poison darnel is a Canadian weed; wire grass is from Europe; wild buckwheat, knotweeds, and goosefoot weeds are all European weeds.

WEEDS FOUND EVERYWHERE.

There are many weeds that are cosmopolitan—found everywhere. Some of these are: purslane, shepherd's purse, clover, knotweed, and bindweed (wild buckwheat).

POISONOUS WEEDS.

Some of the long list of poisonous weeds are: the anemone (wind flower), black henbane, black locust, black nightshade, bloodroot, bouncing beet weed, buckwheat, blub-bearing hemlock, calycanthus, celandine, cocklebur, crowfoot, Indian tobacco, jimson weed, monkshood, poison ivy, sneezeweed, dogbane, water parsnip, and wild black cherry.

POISON IN FLOWERS.

A writer says:

"The alarmist would have us believe that poison lurks everywhere in some form or other. But who would suspect it in the flowers we like to see scattered about. Yet it is a fact that poison is to be found in the posies.

"For instance, the laburnum, which has been compared to a fountain of gold leaping up into the air, is one of the most

poisonous things imaginable, inasmuch as it is poisonous in leaf and flower and seed. Even the grass growing underneath it is poisonous, by reason of its proximity to the innocent-looking blossoms overhead, and it has been found necessary to guard against cattle eating the grass, for fear of fatal results.

"The bulbs of such dainty and beautiful flowers as the narcissus, hyacinth, and snowdrop secrete the most deadly poisons; not to speak of the oxalis, the monkshood, and the foxglove, all of which furnish noxious liquors sufficient to destroy life.

"Despite its innocent appearance, the laughing little buttercup is one of the worst of poisonous flowers. Even the cow avoids it."

THE DISPERSAL OF WEED SEEDS.

It is interesting to note the various ways in which weed seeds are distributed. Some weed seeds are carried in the wind and have "wings," like the tumble weeds, Russian thistle, and milkweed; others fly in the air, having expanding parts, like basswood and balloon vine. Ticklegrass weeds have large heads full of seeds; they are drawn up and carried by the wind, the seed dropping everywhere, and this is the case with many other weeds that fly in the air. Some with inflated pods, like sedges and driftwood, float on the water. Many weed seeds are distributed by melting snow. A great many weed seeds have hooks or barbs on them and "hook on" to animals, birds, and people, and are thus carried away. Many seed pods have exploding power and throw their seed out in every direction; the oxalis, or yellow sorrel, is a noted example. Some seeds have creeping-parts like legs and bury themselves in the ground. Weed seeds are carried by passing cars on railways and by vehicles on road-ways; herds of cattle and droves of sheep and hogs carry weed seeds and help to scatter them.

USEFUL WEEDS.

Some of the vast crop of weeds are useful in medicine. From foxglove the medicine digitalis is obtained; hyoscyamine comes from henbane weeds; daturin comes from jimson weed; tansy and hemp are used in medicine; chicory roots are used for a drink in place of coffee; dandelion and lamb's quarter and mustard are used for vegetable greens; the roots of tanweed are used in tanning leather; and sweet clover is a fine plant for bees.

XLVI.**GRASS.**

And God said, Let the earth bring forth grass, the herb yielding seed, the fruit-tree yielding fruit after his kind, whose seed is in itself upon the earth: and it was so.—*Genesis i. 11.*

Webster gives this definition: "In its widest sense, grass is the green herbage which affords food for cattle and other grazing animals." While it is really true that "the grasses are the foundation of agriculture" and that "grass is king among the crops of the earth," there is another view to be taken of the grass, and that is the part it has in ornamenting and enriching the face of nature. One of the most pleasing and delightful sights to be seen in the natural world around us is, as the poet says, that of the "sweet fields arrayed in living green." What a glorious panorama is spread before us each returning season of spring, when the grasses, which have been slumbering under the snows of winter, spring up everywhere and cover the earth, as with a carpet, rich with color and full of vernal beauty!

DISTRIBUTION OF GRASSES.

Grasses are to be found in all parts of the world; in every soil, in every climate, whether under the burning sun-rays of the equator or amid the frozen ice-fields of Greenland, wherever there is enough moisture and heat, grasses grow and are most notable among all the different forms of plant life. Botanists have divided the whole plant kingdom into families. The botanical name of the Grass family is *Gramineæ*, from the Latin word *gramen*, meaning "grass." The whole Grass family of the world contains about three hundred and seventy-five genera, thirty-five hundred species, and many thousands of particular grasses or specimens.

THE GRASS FAMILY.

The Grass family contains several plants we call "cereal" (grain) plants, because these plants have certain forms of stems, leaves, spikelets, etc., like other plants called "grass plants" or "grass." The cereal grass plants are: Indian corn, wheat, oats, rye, barley, rice, doura, and sorghum. These are food-producing plants for the human race; while the meadow, pasture, prairie, forest, and valley grasses, together with the cereal grasses, furnish food for many of the wild and the domestic animals. There are many plants called "grass" which botanists do not classify as Grass; these are: rib grass, cotton grass, sea grass, eel grass, sedge grass, and the clovers. These plants do not belong to the Grass family, though they are called "grasses."

ASIATIC, EUROPEAN, AND AMERICAN GRASSES.

The following are some of the long list of foreign

and of native Grasses; those following (A) are for pasturage or hay, those following (B) are grain used for food, and those following (C) are ornamental or lawn grasses, as well as grasses used in paper-making, basketry, etc.

(A) Apache blue grass, beard grass, bear grass, Bermuda grass, brook grass, buffalo grass, carpet grass, Colorado grass, cord grass, curly mesquite, downy cat grass, everlasting grass, meadow grass, bunch grass, Kentucky blue grass, timothy, molasses grass, mousetail grass, pony grass, rescue grass, sleepy grass, Texas blue grass, Tennessee grass, windmill grass, and yellow-top grass.

(B) African millet, barley, ditch millet, Indian corn, wheat, rye, rice, doura, crowfoot grass, oats, pearl millet, soft chess grass, teff grass, wild goose wheat, chicken corn grass.

(C) Angola grass, Canadian reed grass, cane, citronella grass, hassock, Japanese grass, Louisiana grass, palm-leaf grass, plume grass, ribbon grass, sweet grass, and zacate grass.

AUSTRALIAN GRASSES.

Some of the Australian Grasses are: bamboo grass, blue star grass, canary grass, dogtooth star grass, feather grass, kangaroo grass, mouse grass, naked cat grass, paper grass, porcupine grass, rat-tail grass, sacred grass, sheep cat grass, silver grass, snow grass, sugar grass, woolly-headed grass, Young's cat grass, and umbrella grass.

GRASS FAMILY AS TO SIZE.

Botanists place the Grass family as *fifth* in the number of the species of plants, and the Sunflower

or Aster family as *first*; that family contains over ten thousand species, yet there is not a fruit, nor a vegetable (so called), nor a good plant for grazing animals in the whole list. Beal, in his great work, "The Grasses of North America," says:

"In the United States, east of the Mississippi River, the grasses constitute about one-twelfth *of all* the species of flowering plants.

USES OF GRASSES.

Grasses are used in several ways: cereal grasses for food or drink (corn in making whiskey); as paper, coarse cloth, sugar; for mats, rugs, hats; bamboo grass for roofs to houses, and many other things; for fuel and for rip-rapping work along the banks of swift rivers, to keep the banks from falling in. Some grasses supply material for cordage, for the plaiting of hats, for baskets; tussock grass is of service in making a barrier against the blowing sands of the desert; oil-of-lemon grass is used in perfumery, and some species of Grasses are used in making bouquets.

PLANT FAMILIES OF MOST WORTH.

Beal says: "All of the flowering plants in the United States include about one hundred and seventy families." Most of the plants that are cultivated to supply man and his domestic animals with food are included within sixteen of the following plant families: the Mustard family, Orangelwort family, Grape family, Pulse family, Rose family, Saxifrage family, Gourd family, Parsley family, Sunflower family, Heath family, Nightshade family, Goosefoot family, Buckwheat family, Gingerwort family, Lily fam-

ily, Grass family, Mallow family, Flax family, and Mint family.

Thus we can see the place Grass occupies in the listed families of American plants. Grass has always been the favorite symbol of the moralist. Isaiah moralizes by saying, "All flesh is grass." The patriarch Job said: "My days are as grass." And David, in Psalms xxiii., exclaims in delight, "He maketh me to lie down in green pastures."

INGALLS ON "BLUE GRASS."

Senator John J. Ingalls paid the following tribute to "Blue Grass" in a fine essay:

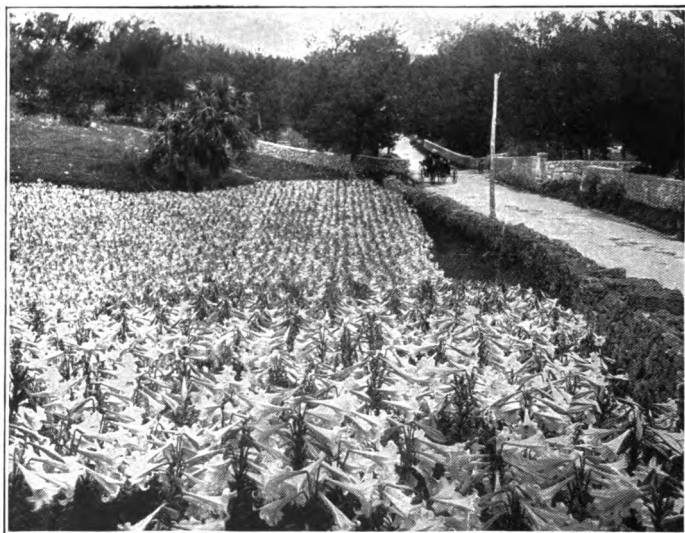
"Next in importance to the divine profusion of water, light, and air, those *three* great physical facts which render existence possible, may be reckoned the universal beneficence of grass.

"One grass differs from another grass in glory. One is vulgar and another patrician. There are grades in its vegetable nobility. Some varieties are useful. Some are beautiful. Others combine utility and ornament. The sour, reedy herbage of swamps is base-born. Timothy is a valuable servant. Redtop and clover are a degree higher in the social scale. But the king of them all, with genuine blood royal, is Blue Grass.

"The primary form of food is grass. Grass feeds the ox: the ox nourishes man: man dies and goes to grass again; and so the tide of life, with everlasting repetition, in continuous circles, moves endlessly on and upward, and in more senses than one, all flesh is grass. But all flesh is not blue grass."



CALIFORNIA FERNS.
Courtesy of Mr. Fred Harvey.



FIELD OF CALLA LILIES.

There are several varieties of Calla Lilies, from the "Little Gems," 1 foot high, to those 6 feet high; there are the Pink and Rose Calla, the Spotted Calla, the Golden Calla, the Black-throated Calla, and the California Calla. The word *calla* is from the Greek *kalos*, meaning "beautiful." Calla Lilies belong to a small family of plants in Africa.

XLVII. FLOWERS.

"There breathes for those who understand
A voice from every flower and tree;
And in the work of Nature's hand
Lies Nature's best philosophy."

"*The flower*, in popular language, is the blossom of a plant composed of delicate and gayly colored leaves or petals." Every complete flower consists of *stamens* (Latin, *stamen*, the warp, a thread) and *pistils* (Latin, *pistillus*, a pestle), together with two sets of leaves, the *calyx* (Latin, *calyx*, a husk, a shell) and *corolla* (Latin, *corolla*, a little crown or garland), which protect them. The *stamens* consist of a stalk, or filament, which holds up a round-shaped body called the *anther*, that is filled with a powdery sort of substance called *pollen*. The *pistil* has a closed cell at its base, containing ovules, and is covered by a style, which ends in what is called the *stigma*. These organs are protected by "the floral envelope." The leaves of the corolla are called *petals*; those of the calyx, *sepals*.

The Flower Kingdom embraces such a vast and endless number of forms that it is impossible to list them in this small space. A few of the world-wide variety of Flowers are: the lady slipper, the orchid cattlyea, the orchid aganisia, amaryllis, passion flower, mignonette, fuchsia, begonia, zinnia, dahlia, phlox, verbena, violet, forget-me-not, petunia, paulownia, moss rose, hyacinth, anemone, moccasin flower, Pasque flower, pentstemon, marigold, crocus, and the clematis.

From the earliest ages of the world, people have admired and cultivated flowers. Flower markets existed in Egypt, Greece, Rome, India, China—in fact, in all the oldest nations of the world. Flowers have always been used for the adornment of persons and of homes—particularly on festive occasions. In many countries flowers are used in connection with all religious rites of the church. Someone has said, “Flowers are the sweetest thing God ever made and forgot to put a soul into,” and the statement is true. In all the wide range of nature, no other creation is quite so beautiful, so delightful to behold, as the flowery kingdom. It is the earth’s richest adornment.

How kind and good the All-wise Creator is to scatter flowers throughout the remotest parts of the globe to gladden the eye and delight the senses. The vast growing, blooming, and ever-reblooming order of the flowers fills the mind with wonder, with love, with admiration, and with gratitude. In all places: in the great silent woods, where wild flowers lift their timid heads to the morning sun as it glances through the tree-tops; in fields, where the air is perfumed with sweetest odor; in the low valleys, where the sunlight seldom falls; on the mountain tops, mid ice and snow, wild crags and rocky steeps; in canyon, gorge, crevasse, and crater; in the gloomy desert even, or by the side of the roaring sea; in dense cities, where fountains bubble in parks; everywhere, everywhere flowers are a blessing, a joy, an ever-returning and refreshing source of pleasure.

As we peer into some parts of the vast creations of the plant and flower kingdom, we find many wonderful things; for example:

CARNIVOROUS PLANTS.

The Venus Fly-trap of North Carolina belongs to a single species, the *Dionæa*. The inner surface of the leaves is provided with very sensitive hairs; when an insect or other object touches these hairs, the hairy leaves of the trap instantly close like two clasped hands over the tubular part of the plant, and the insect is there digested by an acid secretion; indigestible objects, like small pebbles, are soon released.

The Sundew, of which there are six genera and one hundred and twenty-five species, inhabiting bogs and marshes, has leaves provided with viscid glands, by means of which it captures insects.

In the *Darlingtonia* there is a bait, covered with honey and hanging down in the entrance to the tube. This sweet bait encourages the insect to go in, but it never comes out.

The East Indian Pitcher Plant, thirty species of which are cultivated, has pitcher-shaped appendages hanging down from the top of the plant. Some have lids to them, and contain an acid liquid which kills insects that may crawl down into them—the lid closing over the prisoner.

HABITS OF SLEEPING FLOWERS.

In cloudy weather or as night approaches flowers close up and fold up their petals and go to sleep. The daisy closes up its petals at the approach of a storm because the rain might dissolve the nectar it has in it. The nipplewort opens before six and closes before ten of mornings, so that bees may get its store of nectar, and also to keep ants from getting it, as they do not gather their stores until the dew has gone.

DISTRIBUTION OF PLANT SEEDS.

Man has many ways of distributing flowers through the channels of commerce, but Nature has given the flowers themselves the remarkable power of distributing and transferring their species. The jewel weed has five muscular valves, that are like so many elastic springs, which upon the slightest touch coil up, then burst open, scattering the seeds in every direction. The seeds of maple and ash trees have wings. Burr seeds of all kinds have barbs and hooks on them, and they hook on to the animals, and in that way are scattered. Silk grass, dandelion, and thistle seeds have gauzy wings that carry them in the wind. The garden balsam has elastic bursting valves in its pods that throw out seed upon being touched. The common garden sage has a curious device for transferring its pollen and aiding in cross-fertilization.

PECULIAR FLOWERS AND PLANTS.

There are many flowers and plants that have certain characteristic forms and peculiarities; such as: the moccasin flower (which is shaped like an Indian's moccasin), the tiger flower (that is spotted and streaked like a tiger), the Jack-in-the-pulpit flower, the butterfly plant (having leaf colors like a butterfly), the trumpet-shaped flower, the spur, the ray flower, the cock's comb, the dog rose, the dog-tooth violet, the Indian pipe flower (shaped like an Indian's long pipe), the lizard's tail plant, the sham-rock, the passion flower, the kohl-rabi, the buckeye, the egg plant, and the Turk's cap flower.

STATE FLOWERS (*World's Almanac, 1912*).

Following are the *State Flowers*: Alabama. gold-

en rod; Alaska, forget-me-not; Arkansas, apple blossom; California, golden poppy; Colorado, columbine; Connecticut, mountain laurel; Delaware, peach blossom; Florida, orange blossom; Idaho, syringa; Illinois, violet; Iowa, golden rod; Kansas, sunflower; Kentucky, golden rod; Louisiana, magnolia; Maine, pine cone; Maryland, black-eyed Susan; Michigan, apple blossom; Minnesota, Moccasin flower; Mississippi, magnolia; Missouri, golden rod; Montana, bitter root; Nebraska, golden rod; New Mexico, cactus; New York, golden rod; North Dakota, wild rose; Ohio, scarlet carnation; Oklahoma, mistletoe; Oregon, Oregon grape; Rhode Island, violet; South Dakota, anemone; Texas, blue bonnet; Vermont, red clover; Washington, rhododendron; West Virginia, rhododendron; Wisconsin, violet; Wyoming, gentian.

The great desire for flowers and plants has been the cause of their becoming staple articles of commerce in the world. The work of the florist is of the highest importance. Floriculture is a distinct line of work in which thousands are engaged. The development of varieties of high-class flowers is remarkable. Florists, by making careful selections and studying the life and habits of their flowery charges, have been enabled to carry individual and particular plants of superior beauty to a high degree of perfection. Conservatories filled throughout with every modern appliance of art are found everywhere, and thousands upon thousands of rare specimens are reared under influences best tending to their fullest natural growth.

XLVIII.

THE RICE PLANT, THE COTTON PLANT.

THE RICE PLANT.

Rice is one of the most useful and extensively cultivated of all grains, supplying, as it does, the principal food of nearly one-third of the human race. Rice was originally from the East Indies, but it is now cultivated in all quarters of the globe, wherever the conditions of warmth and moisture are suitable. When rice is growing in the field, it looks like barley or oats. It requires very moist ground—in fact, sometimes flooded, swampy land, in southern latitudes. Wet land is the best for rice-growing. The rice-fields of China are kept flooded with water, and the laborers actually wade in great puddles and look after the plants.

Rice is most extensively cultivated in India, China, Asia, Japan, Egypt, North and South Carolina, Italy, Georgia, Spain, and Ceylon. At least one hundred and twenty known varieties of Rice are cultivated. There is a species of Wild Rice which grows in many parts of this country, and was much used by the early Indians for making a nutritious meal. Rice is one of the chief articles of commerce between this country and China. Charleston, South Carolina, is our rice metropolis. In India rice is called "paddy."

The Japanese make a kind of beer of rice, called "saki," and several kinds of rice wines are made by the Chinese. Rice starch is extensively used in laundries. The straw of rice is used to make plaited straw bonnets, and the broken husks make valuable

food for cattle. According to the chemical analysis, rice contains a small amount of flesh-forming substance, and a larger amount of fat-forming or heat-giving substance than any other grain. As a food, it is particularly adapted to warm climates. The Chinese eat rice with two long ebony sticks, and the manner in which they, with only one hand, dexterously move these little rice grains from the plate to their mouths is something wonderful. At Chinatown, San Francisco, California, one sees the finest rice straw specialties and manufactures to be found in this country.

THE COTTON PLANT.

The introduction of the Cotton Plant in the United States can be traced as far back as the year 1336. Cotton seed was planted by the earliest settlers of the southern part of this country, but was cultivated, like other plants, simply to ornament yards and gardens. No one thought at that time of its usefulness, or of the possibility of its becoming the great staple which it is now. About the beginning of the Revolutionary War raising cotton as an article of commerce and trade began. The first shipment was only 2,000 pounds, in the year 1770. In 1791 the total amount of shipments was 189,316 pounds. The invention of the saw-gin was the cause of greater activity in the cotton trade, so we find that 17,789,803 pounds were exported in the year 1800. Most of this cotton was raised either in Georgia or on the sea islands off the coast of Georgia. The Southern people obtained cotton seed from the natives of the Bahama Islands.

When Columbus first came to the American Is-

lands, he found the natives cultivating cotton. The oldest cotton-producing country in the world is India, where the plant has been cultivated from the remotest ages. Mention of the Cotton Plant is made in the early history of Egypt, and it was also raised in Africa in very remote times.

Cotton seed is planted in either March or April. The ground is thoroughly prepared in about the same way as for the cultivation of corn. Cotton is planted in rows, about 3 feet apart, and then it requires a considerable amount of cultivation to make the plants grow. Cotton is both plowed and hoed by the laborers. Small mules, known in market as "cotton mules," are used in plowing cotton. These little animals are extensively raised in Missouri (which, by the way, is the first State in the Union in the production of that necessary domestic animal, the mule), and these mules command a steady price. As the cotton plant develops from time to time it changes its appearance. Pale, yellow-looking leaves appear on the plant, and then these drop off and leave a pod, in which the cotton bloom is found. In the course of time this bloom puts out, and the whole field looks very beautiful.

The "cotton-picking season" is about the month of August, and it is always a great occasion at the plantation. In former years, when the cotton-fields of the South were cultivated by Negroes, "cotton-pickings" were occasions when large crowds of colored laborers marched to the fields, making the air ring with the sounds of happy plantation songs, and, with baskets on their shoulders, picked the snowy cotton blooms and carried them back to the big cotton barn, where other colored people were sing-

ing and picking the seeds. The "cotton-picking season" was always the occasion of a continuation of cabin dances in the "quarters."

In 1793, Eli Whitney invented the cotton gin, a machine for cleaning cotton, and an invention that gave the trade a wonderful boom. Cotton seed is remarkably rich in oil, and is used for many purposes. Cotton-seed cake is made and fed to stock to fatten them. The seed is boiled and then mixed with hay or straw. Cotton-seed oil is a good substitute for lard in cooking.

The United States is the most extensive cotton-producing country now in the world, and India is next. Cotton is raised in Brazil, in Spain, in Egypt, in the West Indies, in the East Indies, and in other countries. It is one of the staple articles of commerce, and the chief source of wealth in the Southern States. It is verily true that in the South "Cotton is king." In 1896-7 the United States consumed 2,738,000 bales of cotton, and exported to Europe 4,885,326 bales.

There was a cotton famine from 1861 to 1864, during the war between the States, and this was owing to the fact that all business was interrupted and but little cotton raised. Northern factories closed down, factories throughout Europe depending entirely on the American crop suspended, and tens of thousands of cotton mill and factory hands, thousands of them females, suffered greatly.

XLIX.

THE MATE PLANT, THE EGG PLANT,
THE TARO, THE MANIOC.

THE MATE PLANT.

The Mate Plant is a bush, looking something like the holly bush, that grows in South America; the bush sometimes grows as high as an orange tree. The leaves are green all the year, and the young leaves are used for tea. The laborers who gather the mate leaves are called "*yerbataros*." Mate is a drink that the South American Indians found to be good, and they persuaded the Spaniards to drink it. It is now the favorite beverage in many South American countries. It is also called "Paraguay tea." It is much like coffee and tea in its effect to stimulate the system. In Argentina they use *seven times* as much mate as coffee. A great deal of mate is used in Brazil, although that is the greatest coffee-producing country in the world. Mate is a fine nerve and brain stimulant, and men that are on a strain all day at work have to have their mate for breakfast. The *guachos*, or cattle herdsmen, drink a great deal of mate. It is almost the universal drink among the hard-laboring classes in Paraguay.

The mate or tea forests are called "*yerbales*." When the time comes for the laborers in the mate forests to gather their crop, they cut off the small branches and take them to drying-houses, and they are placed on the roofs of the houses to dry. Fire, made of sweet-smelling wood, is kept up until the leaves are perfectly dry; then they are pounded

and mashed up until they are in a condition of coarse meal. The mate is then put into sacks, made of rawhide, and they are carried to market on the backs of mules. Over a million dollars' worth of mate is packed and sold in Paraguay every year. Villa Concepcion is a great mâte-shipping port.

THE EGG PLANT.

The Egg Plant is a native of the East Indies. It is an annual plant that grows about 2 feet high, with a stem that is hard like wood. The fruit is very much like an egg in shape; the color is generally white, yellow, or violet. In size the fruit varies from a hen's egg to the egg of an ostrich. It is a very popular food plant in many of the warm countries of the world. It is known by the names of "Egg Apple," "Auberjune," "Brinjal," etc., etc. The Egg Plant is an ally of the Potato. The fruit is usually sliced, then dipped in a batter with bread crumbs and fried, and when so prepared is a fine food. The Egg Plant is extensively cultivated in Louisiana. It is popular as a garden vegetable in warm climates where the plant can be raised. The botanists classify the Egg Plant as belonging to a family of plants called the *Solanaceæ* (from the Latin *solanum*, meaning "night shade"), the Nightshade family. The family embraces over one thousand species, widely distributed in temperate and tropical regions. A few species, as *Solanum tuberosum* (the Potato) *Solanum esculentum* (the Tomato), and *Solanum melongena* (the Egg Plant), are excellent food plants.

THE TARO PLANT.

The Taro Plant is stemless, with large heart-shaped leaves, sometimes called "elephant ears." It is widely cultivated throughout the tropical and semi-tropical countries for food, particularly in India, China, Australia, Africa, the Hawaiian Islands, the Philippines, and other islands of the Pacific Ocean, as well as the West Indies. In the temperate regions the plant is cultivated for a garden ornament. It is the world's leading food plant, as more people eat taro than any other plant whose root-stocks furnish food.

The taro has an acrid, bitter, and unpleasant taste in its raw state, all of which is destroyed when the root-stock is baked, boiled, roasted, or cooked with vegetables for food. The plant furnishes an excellent quality of starch and a kind of flour is made from the dried root-stock. The Taro and the Potato are the two chief staple food plants of the earth. What the Potato is to Europe, the Taro is to the tropical and semi-tropical countries of the world. The Taro has been a food plant for many centuries. It is a native of India.

THE MANIOC PLANT.

Manioc, or *Cassava*, is a food plant which is cultivated in South America, in the West Indies, and in parts of Asia and Africa. The roots are the parts of the plant that furnish food. They are large and full of starch and other food matter. South Americans eat manioc roots baked, roasted, or boiled, as we do sweet potatoes or Irish potatoes. The roots are dried and ground into flour, from which bread and cakes are made. The Manioc Plant fur-

nishes an excellent food to millions of people in the tropical countries of the world.

L.

THE COFFEE PLANT, THE TEA PLANT.

THE COFFEE PLANT.

The beverage, which is so much prized at the breakfast-table, is made of a small bean or berry



COFFEE IN BLOSSOM, COSTA RICA.

that grows on a bush from 8 to 10 feet high, and is found in many of the tropical countries of the world. These little trees grow in clusters and form coffee forests. The odor of the coffee is delicious. The

little coffee tree puts out flowers during eight months of the year, in the West Indies, Brazil, and other countries of South America. There is not much accurate knowledge of the early history of the Coffee Plant. We find no statement of the fact that coffee was known to the Greeks or to the Romans, but in Abyssinia and Ethiopia it was used in very remote times. Coffee was used in Arabia in the fifth century, and all over the rest of the East in the sixteenth century.

There are a great many varieties of Coffee: Mocha, Java, Rio, Jamaica, Mexico, East Indian, Bourbon, Brazilian, Haytian, and so on.

There are many substitutes for coffee: chicory, dandelion root, carrot roots, rye, wheat, yellow iris seeds, and several others. In some parts of the world, leaves of the Coffee Plant are used in place of the seeds. This is the case in Sumatra, where the leaves are dried like tea leaves in China, and the coffee is made in much the same manner as tea is made.

The world trade in coffee is something enormous. Coffee is a universal table drink. Millions of tons of coffee are consumed by the different nations. The United States, in 1911, used 833,066,000 pounds of coffee; Germany, in 1910, 375,883,000 pounds; France, in 1910, 245,964,000 pounds.

The leading coffee-growing countries are: Brazil, Colombia, Venezuela, Ecuador, Peru, Bolivia, Central America, Mexico, and Porto Rico.

Making a good cup of coffee is one of the highest accomplishments in cooking. The French pride themselves on being the best coffee-makers in the world. One of the most famous places in the United

States to get a cup of genuine French coffee is at the French Market in New Orleans.

THE TEA PLANT.

All that is known of the early history of tea, the great beverage which we all so much enjoy, is that it appears to have been used for ages in China. It first became known to the Europeans about the beginning of the sixteenth century. The Tea Plant, or shrub, in a proper state of cultivation, reaches a height of 6 or 7 feet. It has a fine flower upon it, giving forth a delightful odor. Tea plants live about thirty years.

The tea farms are generally of small size. The planters put their plants about 4 feet apart, and they must be kept free from weeds. The China tea planter and cultivator is extremely careful in the culture of his plants. Every pains is taken to see that the plants are matured at the proper time, dried at the proper time, colored at the proper time, packed in boxes in the proper way, and shipped to the best market. We have no class of farmers who are more particular with their crops than the China tea-raiser.

The Tea Plant is thought to be sub-tropical, but bears in a tropical climate well, and can also accommodate itself to cold winters. Tea has been raised in the vicinity of London, and during all the frosts of an English winter, without protection. Tea has been grown in New Zealand, Sicily, Italy, France, Brazil, and other countries. The native home of Tea is China and Japan.

On the China tea farms, when the leaves are freshly plucked, they possess nothing of the odor

or flavor of the dried leaves. The process of drying the leaves changes them very much, both in respect to color and to taste. Green teas are roasted in pans almost immediately after they are gathered; after about five minutes' roasting, during which time the leaves make a crackling noise, they are



PICKING TEA LEAVES.

rolled and rolled by the hands, and then they are re-roasted until their color is fixed. The coloring is done by placing into the pans a certain glutinous kind of substance, which glosses the leaves. In making black tea, the leaves are spread out in the air for some time after they are gathered; they are then tossed about, then rolled, and lastly they are dried over charcoal fires until the black color is

fairly brought out and set. For the purpose of giving a special scent to the tea leaves, the artful Chinese put in cowslip, colored blossoms, sweet-scented olives, and other aromatic plants. Sometimes the Chinese put in small quantities of Prussian blue, or a species of native indigo or gypsum. The coloring is never made by roasting the tea on copper pans, as many believe.

In China tea is seldom used until it is one year old, owing to the intoxicating effect. Japan and Java export tea to Australia, Europe, America, and all parts of the world.

There are many varieties of teas: Pin-head, Gunpowder, Young Hyson, Foo-Chow-Foo, Scented Orange, Imperial Hyson, Flowery Pekoe, Souchong, Assam, and so on. The excellence of tea as a popular beverage is well known to all.

LI.

VEGETABLES.

"A vegetable is a plant cultivated for food; as the cabbage, turnip, potato, bean, etc." (*Webster.*)

The Vegetable Kingdom consists of all of the known species of plants in the world, arranged in classes, orders, branches, etc.; there are over two hundred thousand in all. It will be seen at once that this is a wide, wide subject. We can not in such a small space treat of the whole Vegetable kingdom, but can consider *particular* vegetables or *particular parts* of the kingdom. The name "vegetable" is from the Latin word *vegetare*, to quicken, to animate; vegetables are the life-animated, grow-

ing forms of plants that yield food. Only certain parts of plants are eaten as vegetable food, and these consist of: the seeds, roots, stalks and leaves, fruits, bulbs, flower buds, flowers, leaf buds, and pods.

Some of the chief plants producing only seed for vegetable food are: corn, peas, Lima beans, and navy beans; those whose roots only are eaten are: radishes, beets, horseradishes, carrots, the taro, the mandrake, salsify, parsnips, and sweet potatoes; those vegetables whose stalks only produce food are: celery, asparagus, sea kale, cardoons, and rhubarb; those whose stalks and leaves furnish vegetable food are: cabbages, savoy, and lettuce; those whose flower buds are eaten are: broccoli, capers, and cauliflower. Cauliflower is, Mark Twain wittily said, "a cabbage with a college education." Those plants whose flowers only furnish vegetable food are: the lily, the artichoke; those whose fruits only are eaten as vegetables are: the tomato, okra, the egg plant, the squash, the pumpkin, the cantaloupe, and the watermelon; the one whose leaf buds only are eaten is the Brussels sprouts; those plants whose bulbs only are vegetable food are: the onion, garlic, the potato, shallots, the turnip, leeks; and those plants whose pods or shells are eaten as vegetable food are: fresh beans, peas, frijoles, and lentils.

ORIGIN OF THE VEGETABLES.

It is about as hard to trace out the original homes of vegetables as it is to find out the first dwelling-place of our domestic animals; yet, by careful research, much of the history of the vegetables has been found out. Of the one hundred and fifty-seven cultivated plants listed by M. Candolle, eighty-five

of them have been found growing wild, and this is not all that are wild.

The *potato*, called "the king of vegetables," closely related to the tobacco plant, belladonna, henbane, and other poisonous plants, is a native of South America; the *parsnip* is a native of Great Britain; the *carrot*, cultivated by the ancient Greeks and Romans, is a native of southern Europe; *cabbage* was first cultivated in Great Britain by the Saxons; *turnips* were first grown in Germany; the *tomato*, somewhat poisonous in its wild state, though made eatable by cultivation, is a native of America; *rhubarb* was first cultivated in China; *lettuce* is of tropical origin.

LII.

FRUITS, BERRIES, NUTS.

FRUITS.

Fruit, in Botany, means what plants bring forth, the ripened egg, the product; it is not confined alone in its meaning to such juicy products as apples, pears, peaches, etc., etc.

Fruits are of two kinds, with regard to their place of growth: wild fruits and cultivated fruits. According to their coverings, fruits have furry skin coverings, like the peach; smooth skins, like the apple, pear, quince, apricot, nectarine; thick skins, as the fig; thin skins; thin rinds; thick rinds; shell coverings, like the cocoanut; leathery rinds, containing oil glands, like the orange and the lemon; hard rinds, like the pomegranate; and soft, thick skin coverings, like the banana.

Fruits have one seed, two seeds, several seeds,

a great many seeds (the fig is all seeds), and then no seeds, like the banana and some varieties of the orange. *Deciduous fruits* are those that fall off when they ripen; *fleshy fruits* are those in which some of the flesh sticks to the seeds after removal.

Fruits, as we all know, are eaten raw, cooked, dried, canned, and preserved. The products of fruits are many and cover a large part of any grocer's stock of goods. Apples (and there are far too many kinds to be enumerated here) are dried, made into apple butter, marmalade, jelly, cider, apple vinegar, and apple brandy; grapes (and their kinds are very numerous) are made into jelly, wine, argols, and raisins; olives are pickled or made into oil; oranges and lemons are made into orangeade, lemonade, marmalades, and candied preserves; plums are made into butter, dried, and canned; prunes are dried and canned; and so on through the long list.

ORIGINAL HOMES OF CERTAIN FRUITS.

Apples, pears, and currants are natives of Europe; peaches, plums, oranges, figs, and cherries came from Asia; the date is an African fruit; navel oranges came from South America; the papaya is from Central America; the papaw, called "the American banana," is a native of the United States; the kangaroo apple is from Australia; the tamarind is from India; the strawberry is from the West Indies; some fine Oriental fruits are the Malay curry, the mango, the mangosteen, and the durion.

The cross-grafting of plants is a plan which has produced some wonderful results. Mr. Luther Burbank, of Santa Rosa, California, has made some wonderful discoveries in crossing plants, vegetables,

etc. His experiments have extended over a wide range of fruits, flowers, vegetables, and trees. He has, by growing certain plants together or by putting parts of one with another, brought about some most singular things; for example: he has grown apples that are sweet on one side and sour on the other; flowers and fruits changed entirely in their original colors and made to grow to be of great size; he has produced, by certain lines of cross-cultivation, the desert cactus without any thorns or spines, and made the cactus good to eat; he has greatly increased the yield of the prune crop; made rhubarb to grow months earlier than the old kind; he has cultivated certain kinds of *white blackberries*, and also grown blackberry bushes without any thorns on them; he has made trees to produce stoneless plums and prunes, vines to grow seedless water-melons, stalks that grow huskless corn, fields of *crimson-colored* poppies, groves full of walnut trees of much larger size than the old kind of trees, orchards full of quinces that taste like pineapples; and so on and so on.

BERRIES.

Berries are bush-fruits.

Barberries are of six kinds: Common Barberry, a native of Great Britain; American Barberry, chiefly found in mountain canyons; Fremont Barberries; Three-leaved Barberry, fruit used for tarts, etc.; Magellan Barberry; and the Nepaul Barberry, a native of India. In England the leaves of barberries are sometimes used in salads.

Strawberries are so called because the climbers and fine tendrils on the plant resemble straw. The

Strawberry is called "the king of berries." Fuller lists six species: the Alpine Strawberry, a native of both Europe and America; Green Strawberries; Hautboies Strawberries, a native of Germany; India Strawberry, a species with yellow flowers, not edible, a native of India; Virginian Strawberries; and Flowering Strawberries, a native of South America.

Strawberries were eaten in ancient times and are mentioned by Roman writers. The Roman poet Virgil has these lines:

"Ye boys that gather flowers and strawberries,
Lo! hid within the grass a serpent lies."

Fuller, in his "Small Fruit Culturist," enumerates fifty-eight fixed varieties, forty miscellaneous varieties, and forty-two foreign varieties of Strawberries, the largest of which is the Great American.

Raspberries.—The Old English name was "the Hindberry," so called because stags and hinds ate them. "Rapis" is a wine made from raspberries, and the berry was so named from its taste. Dr. Gray divided them into three classes: 1, *Purple Flowering, White Flowering, Cloudberries*; 2, *Showy Raspberries*; 3, *Bird's-foot Raspberries, Dwarf Raspberries*. These classes are sub-divided into many other kinds; such as, the American Black, American White Cap, American Improved, the Caroline, the Davidson Thornless, the Gregg, the McCormick, the Ohio Everbearing, the Seneca, the Summit Yellow Cap, the Surprise, etc., etc.

Palladius, a Roman writer on agriculture, of the fourth century mentions raspberries as a cultivated fruit in his time. Raspberries of some kind grow in nearly every country in the world.

Blackberries.—There are about one hundred and

fifty species distributed over a great portion of the globe. There are six native species in the United States: the Common High Blackberry, the Low Blackberry (or Dewberry), the Running Swamp Blackberry, the Sand Blackberry, the Low Bush Blackberry, and the Columbia River Blackberry. These species are sub-divided into many kinds, too numerous to mention.

Cherries.—Cherries grow wild and also in a cultivated state. The wild species consist of: the Bird Cherry, the Black Cherry, the Laurel Cherry (having prussic acid in its leaves and fruit, hence poisonous), the Brush Cherry, the Beech Cherry, the Pin Cherry, and the Choke Cherry, etc., etc. The cultivated species consist of: the Amanuelles, the Morellos, the Heart Cherries, the Dukes, and the Mazzards. Carnelian Cherries are natives of southern Europe and eastern Asia. The name is derived from the Latin word *carnu*, a horn, because of the hardness of the wood. The ancients used the hard wood for javelins and spears. Homer, in the *Odyssey*, Book XIV., says:

“His carnel spear

Ulysses waved to rouse the savage war.”

Currants are small seedless raisins, grown chiefly in the Oriental countries, used extensively in cooking and confectionery and in making currant wine. Fuller gives six species: the Fetid Currant, the Wild Black Currant, the Red Currant, the Missouri Currant, the Red Flowering Currant, and the Black Currant—with many foreign and native varieties. People of Siberia use the leaves of the Black Currant for making a kind of tea. Currants are natives of Europe.

Gooseberries are smooth berries with a sharp, acid taste, chiefly used in the preparation of jam, preserves, tarts, pies, etc.; also in gooseberry wine. Dr. Gray gives the following species: the Wild Gooseberry, the Smooth Gooseberry, the Swamp Gooseberry, and the Mountain Gooseberry. Webster says the name "gooseberry" is an alteration of the German word *krausebeerie*, meaning "crisp, sour." There are many foreign varieties. English nurseymen enumerate about three hundred kinds in their catalogues.

Cranberries are bright red acid berries used for making sauce, jellies, tarts, etc. The name was originally "Craneberries," from the fact that the fruit stem is crooked like a crane's neck, and also because cranes like the berry. Three species are listed by Fuller: Small Cranberries, Common American Cranberries, Bush Cranberries. Cranberries originally came from northern Europe.

Huckleberries are dark blue-colored berries; the name is also applied to several kinds of *Blueberries*. Five species are listed: Blue Dangleberries, Black Huckleberries, Dwarf Blueberries, Canada Blueberries, and Swamp Blueberries.

NUTS.

"A nut is a hard-shelled fruit, having an interior kernel or meat." (*Webster*.) Nuts are of three kinds: Tree Nuts, Bush Nuts, and Ground Nuts.

The Tree Nuts are: the hickory nut; the walnut; the pecan; the acorn, from oak trees; the almond tree nut; the pignut, a species of hickory nut; the cocoanut; the betel nut, the nut-like seed of the betel palm tree; the chinquapin, a small sweet acorn; the

beech tree nut; the cashew nut of the tropics; the American butternut; the ginkgo nut of China, Korea, and Japan; the lichi nut of Asia; the candle tree nut of the tropics; the tabebuia nut of Zanzibar; the pine tree nut; the Australian nut, with a flavor like an almond or filbert; the Brazil nut; the nutmeg tree nut; the cacao tree nut (or seed pods) of South America, the West Indies, and Central America, used in making cacao, chocolate, cacao butter, and the manufacture of soap, etc.; the buckeye nut; the pistachio nut, found in Europe; the paradise nut and the cream nut of South America; canary tree nuts from the Canary Islands.

The Bush Nuts.—The chief edible Bush Nuts consist of the hazelnut and the filbert.

The Ground Nuts chiefly consist of the peanuts and the chufa nuts (or "ground almonds" of southern Europe, that hogs are fond of).

NUT PRODUCTS.

Nuts of various kinds are made to yield many valuable products; for example:

Nut Butter is made from peanuts, cocoanuts, almonds, and Brazil nuts.

Nut Paste is made from different nuts, particularly almonds, by putting with them water and starch. "Marzipan" is a well-known almond paste preparation, largely used by confectioners; macaroons are made from ground almonds or almond paste.

Nut Syrups are made from ground nuts, being put in to give flavor to boiled sugar and water.

Nut Flours are made of nuts ground into flour. Italian peasants during certain seasons eat chestnut

cakes made from chestnut flour, and breads and puddings are made from acorn flour. A half-pound or more of chestnut flour made into porridge for breakfast, chestnut cakes for dinner, and chestnut porridge, macaroni, and a fried fish with some cheese for supper comprises many a poor peasant's food for the day.

Nut Candies.—Nuts are extensively used in the manufacture of all sorts of candies; as caramels, pinoche, chocolates, sugared almonds, burnt almonds, nut brittle, nougat (of Oriental origin), made of nuts and honey.

Nut Coffees.—Several substitutes for coffee are made, but peanut coffee and acorn coffee are the most common.

Nut Oils.—Almond oil, walnut oil, beechnut oil, and Brazil nut oil are used as salad oils in South America; peanut oil is also used for salads.

The ever-increasing demand for nuts in this day has brought new conditions. Nuts, in place of being luxuries, growing wild everywhere and to be gathered by anybody, are now cultivated, and there are chestnut forests, almond orchards, peanut fields, cocoanut groves, pecan groves, etc., where nut-growers reap an immense profit from their belongings. In 1905 the total quantity of almonds, cocoanuts, Brazil nuts, filberts, peanuts, walnuts, and other nuts, both shelled and unshelled, imported into the United States was 86,238,000 pounds, with a value of \$6,138,000. From all this we can see of what great commercial importance nuts are, and how much they help to supply the domestic wants of many people in the world.
